This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

LIBRARY
UNIVERSITY OF
CALIFORNIA
SANTA CRUZ

Univ. of California
Withdrawn

LIBRARY
OF THE
UNIVERSITY OF CALIFORNIA.
GIFT OF
Calif. State Printer
Class

SECOND BIENNIAL REPORT

OF THE

COMMISSIONER OF HORTICULTURE

OF THE

STATE OF CALIFORNIA

FOR 1905-1906.

ELLWOOD COOPER, Commissioner.

LIBRARY OF THE UNIVERSITY

SACRAMENTO:
W. W. SHANNON, : : : : SUPERINTENDENT STATE PRINTING.
1907.

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

ELLWOOD COOPER	Commissioner	Santa Barbara
JOHN ISAAC	Secretary	San Francisco
ED. M. EHRHORN	Deputy	Mountain View
E. K. CARNES	Assistant	Riverside
O. E. BREMNER	Assistant	Santa Rosa
CHAS. T. PAINE	Assistant	Redlands
FREDERICK K. MASKEW	Assistant	Long Beach
GERTRUDE BIRD	Stenographer	Sacramento

OFFICE:

Room 41, State Capitol, Sacramento.

Branch Office, Room 11, Ferry Building, San Francisco.

S
39
A331
1905-06

CONTENTS.

PAGE

REPORT OF COMMISSIONER OF HORTICULTURE, FOR 1905 7

REPORT OF COMMISSIONER OF HORTICULTURE, FOR 1906 13

REPORTS OF THE DEPUTY COMMISSIONER OF HORTICULTURE 20

REVIEW OF THE FRUIT SEASONS—1905 AND 1906 28

ENTOMOLOGY IN OUTLINE. By John Isaac 37

THE COCCIDÆ OF CALIFORNIA. By Edward K. Carnes 155

INSECTS OF THE YEAR. By Edward M. Ehrhorn 223

THE CODLING-MOTH PARASITE (*Caliephialtes messer* Grav.) 231

THE GYPSY AND BROWN-TAIL MOTHS 236

THE PEACH BLIGHT. By Charles T. Paine 239

RECLAMATION OF ALKALI LAND NEAR FRESNO. By Clarence W. Dorsey 251

AN EXPERIMENT IN SILK-RAISING. By Kigoraw Kurosawa 261

REPORTS OF COUNTY BOARDS OF HORTICULTURE 273

PROCEEDINGS OF THE THIRTY-SECOND FRUIT-GROWERS' CONVENTION 321

OFFICE STATE COMMISSIONER OF HORTICULTURE,
STATE CAPITOL,
SACRAMENTO, CAL., January 2, 1907.

To His Excellency, GEORGE C. PARDEE, *Governor, and the Honorable the Senate and Assembly of California:*

I have the honor to submit herewith the second biennial report of my office, showing the operations of the Commission of Horticulture for the years 1905 and 1906.

Respectfully submitted.

ELLWOOD COOPER,
Commissioner.

Attest:
JOHN ISAAC, Secretary.

OF THE
UNIVERSITY
OF
CALIFORNIA

REPORT OF THE COMMISSIONER OF HORTICULTURE, FOR 1905.

OFFICE OF THE COMMISSIONER OF HORTICULTURE,
STATE CAPITOL,
SACRAMENTO, CAL., January 30, 1906.

To His Excellency, GEORGE C. PARDEE, *Governor*.

SIR: In accordance with the provisions of the Act creating the office of State Commissioner of Horticulture, Section 10 of which reads: "It shall be the duty of said State Commissioner to report, in the month of January in each even-numbered year to the Governor, and in each odd-numbered year to the Legislature of this State, such matters as he may deem expedient or may be required either by the Governor or Legislature, and to include a statement of all the persons employed, and of moneys expended under this Act, by itemized statement thereof," I have the honor to submit to you herewith the report of the department under my direction for the calendar year 1905, together with a financial report for the fifty-sixth fiscal year and the first half of the fifty-seventh fiscal year.

HORTICULTURAL QUARANTINE.

Since making my last report, the work of the quarantine department of this office has so largely increased that I have found it necessary to engage additional assistance to carry it on successfully. There has been a very large increase in the tonnage arriving in San Francisco, with a corresponding increase in the importation of trees, plants, fruits, etc., requiring inspection and curative treatment, where curable diseases or pests were discovered. Should the duties of this branch of the office continue to increase in the future as in the past, further assistance may be needed.

All incoming vessels are watched for and boarded, and all classes of vegetable products are carefully inspected before being allowed to land. If such importations are free from insect pests and diseases they are allowed to pass; if found infested with pests already established here, they are submitted to proper treatment for their disinfection; but if affected with any diseases or pests not already in our State, they are deported or destroyed. By these means we have succeeded in keeping out numerous pests, any of which might have proved a serious menace to the great fruit industry of California.

In connection with the quarantine work of the Commission, I have established stations at San Pedro and San Diego, and appointed deputies to act at each one of these points. Shipments of trees or fruits from foreign ports are sometimes made to each of these ports, and heretofore we have had to rely upon the County Horticultural Commissioners to do the required work. In such cases they were operating without proper authority. By the appointment of Deputy State Horticultural Commissioners, under direct instructions from this office, all necessary authority is vested in them.

PARASITIC WORK.

In connection with our quarantine work in the San Francisco branch, we also conduct an insectary for the propagation of beneficial, predaceous, and parasitic insects. While our accommodations for this work are very limited and altogether unsuitable for the best results, we have, nevertheless, bred and distributed to all parts of the State large numbers of beneficial insects, and have received excellent reports as to their work in checking the spread of injurious species.

The work of exploring foreign countries for beneficial insects, for which purpose an appropriation was made by the last session of the Legislature, has been continued through the year, George Compere having been retained in the work. Efforts were made to secure his services wholly for our own State, but as this was found impracticable on account of his contract with the West Australian Government, an arrangement was made with the latter government similar to that heretofore existing, whereby California and West Australia availed themselves jointly of his labors and pro-rated the expenses. Under this arrangement we have received several shipments of beneficial insects from different parts of the world, which have been cared for and bred in our San Francisco insectary.

INCREASED ACCOMMODATIONS.

The increasing business of our San Francisco branch and the necessity of having more room for our insectary, compelled us to secure larger quarters. We have therefore leased from the Board of State Harbor Commissioners three large rooms in the Ferry Building, which will serve our purpose, temporarily at least. Conditions there, however, are not favorable to the best results in insect propagation, for it is necessary that we have a properly constructed building, affording proper accommodations of light, warmth, and moisture, and situated in a neighborhood where suitable soil can be secured for growing trees and plants for food for the injurious insects which serve as food for the beneficial species.

Next to the quarantine work, by which destructive species are excluded, this one, by which checks upon the injurious species already with us are introduced, propagated, and distributed, is the most important work of this Commission, and it is one that we can not afford to ignore or neglect.

BENEFICIAL INSECTS.

Reports received from all portions of the State, where recently imported parasitic insects have been established, are very encouraging. The successful establishment of a new insect is always a matter of doubt. Differing conditions, variations of seasons, difference of food supply, and many other contingencies enter into their successful establishment, and it is therefore unsafe to predict absolute success until several years have elapsed.

The *Scutellista cyanea*, the internal parasite of the black scale (*Saissetia oleæ*), may be pronounced a success. It has been established a sufficient length of time to become thoroughly established, and has increased enormously, until it is found in ample quantity wherever the black scale is found, and the latter pest is surely and rapidly decreasing before its advance. We may always expect outbreaks of the black scale, for an insect once established can never be exterminated, but at the same time we may regard the black scale as removed from the list of our dangerous insect pests.

Caliephialtes messer, the parasite of the codling-moth, is still in the experimental stage, but gives promise of doing effective work. We have found the insect breeding in the orchards where it was established, so that we have already several generations of California-bred insects of this species, and may safely conclude that it is permanently established; we have also found that it is doing good work. We are still propagating and distributing this parasite, but owing to difficulty in securing codling-moth larvæ in sufficient quantities, we are seriously handicapped in this work. I have been informed that large quantities of these larvæ can be had from New Zealand, and I have written to the Department of Agriculture of that State for a large supply, promising in return to furnish them with the parasite. In the Watsonville district, from whence we had hoped to draw our largest supply of food, the codling-moth was less troublesome than usual, owing to climatic conditions, and we were disappointed in not getting a sufficient supply of food to insure the greatest development and increase in this valuable parasite this year.

As in other years, we have also bred and distributed large numbers of other parasitic and predaceous insects, among them the *Vedalia cardinalis*, *Novius koebelei*, *Rhizobius ventralis*, etc. We have been propagating these insects steadily for many years to prevent their loss to us, and so that we would have them in readiness for any outbreak of their host pests at any time.

THE MEXICAN ORANGE-WORM.

On invitation of the Mexican Government, an agent of this department was commissioned to investigate the extent and spread of the so-called Morellos orange-maggot in the Republic of Mexico. A thorough study was made of the habits of this pest, its habitat, territorial area, danger to be apprehended from its possible introduction into our State, and other matters connected with it. The result of this investigation has been published in full in a report issued from this office, but I may add that the effect has been to greatly lessen the alarm which our orange-growers were under in regard to this pest, and to encourage the Mexican Government in the taking of effective measures for its control. At the present time our sister republic, stimulated to the work through our efforts, is taking every possible measure to check the pest within her own borders, and to afford us every possible guarantee against its introduction into our State. We are receiving weekly reports from Professor Herrera, who is in charge of the work, showing the number of orchards inspected, the number of oranges condemned and destroyed, the condition of the orchards, etc. All of which gives us as full a guarantee against the introduction of this dangerous pest across our borders as is possible.

CHECKING THE PEAR BLIGHT.

On your Excellency's suggestion, the Department of Agriculture at Washington, D. C., has detailed Prof. M. B. Waite, the leading authority on pear blight, to take up the work of fighting this, the worst of our tree diseases on this Coast. Professor Waite has already made several visits to the afflicted sections, and his first assistant, Professor Scott, is working with us during the winter under his direction. To carry on this great work, the last Legislature made a liberal appropriation, to be used by the Regents of the State University, and that institution has had a large force of men at work in the effort to check this disease. In connection with the Department of Agriculture and the State University, our Commission has been coöperating in this important work, and we have aided in every manner possible in its effective prosecution. I am pleased to report that with the hearty assistance of the various County Horticultural Commissioners, who have lent themselves enthusiastically to the work, the pear blight is becoming well known, and the method of control has been very widely discussed. We may reasonably hope that with the present campaign of education continued for another season, all who are interested in this work will be well informed in relation thereto, and that through the County Horticultural Commissioners we may be able hereafter to keep it under fair control.

PUBLICATIONS.

During the year just passed we have issued a number of publications from this office, among the most important being the following: First Biennial Report of this Commission; Report of the Commissioner appointed to investigate the prevalence of the *Trypeta ludens* in Mexico; A compilation of the horticultural statutes and county ordinances of California; The Russian Thistle, its introduction and spread in California, with laws and measures for its control; Insects and insecticides; Fungi and fungicides; and The pear thrips.

Besides these, we have commenced the issue of a monthly circular, in which is set forth such matter as may be of interest to the County Horticultural Commissioners. We have also published the consular reports as the same have been received from Washington. There is a very great demand for these publications among the horticulturists of the State.

CONSULAR REPORTS.

I am pleased to report some improvement in the consular reports. Sometimes these were held in Washington for several days, and sometimes it was several weeks before they were forwarded, with the result that the information they conveyed was too old to be of service. An agent of this department called upon Mr. Louis G. Reinburg, Acting Chief of the Bureau of Trade Relations, Department of State, in Washington, and found that the delay was due to the reports being held for indexing, and upon representation of the need of these being in the growers' hands at the earliest possible moment, arrangements were made for expedited service. Other improvements might still be made in this service to render it more profitable to our horticulturists.

FRUIT-GROWERS' CONVENTION.

The Thirty-first California Fruit-Growers' Convention was held this last year at Santa Rosa, and I am pleased to report that, so far from these meetings losing their interest, they are increasing each year, and the last was in all respects one of the best ever held. The papers presented on that occasion were eminently practical, the debates intelligent and unmarked by any spirit of acrimony, and there was a feeling of good-fellowship among all present rarely experienced in public assemblies where so many are gathered together.

HORTICULTURAL CONDITIONS.

It gives me great pleasure to report that the past season has been one of the most prosperous in the history of horticulture in this State. It was not, however, without its drawbacks, and the chief of these were the devastation wrought by the pear blight in our Bartlett pear sections, the shortage of the peach crop, and a light prune output. Other varieties yielded fairly well, although the fruit crop was somewhat spotted; but withal, the demand and prices were so unusually good that most growers made a handsome profit on their crops. Table grapes have been an especially profitable fruit. We have received better service from the railroads than usual, and, with the exceptions noted, the season has been very favorable to the fruit-grower.

In conclusion, I wish to state that in all my labors I have received uniformly courteous treatment, and in every case where assistance has been required in the discharge of my duties it has been willingly accorded. This is especially true of the customs service of San Francisco, from the officers of which we have received very valuable assistance in the prosecution of our quarantine work at that port.

I wish, also, to add that I have found the employés of my department uniformly efficient and energetic in their respective branches, and the efficiency of the work of the Commission under my direction is largely due to the willingness and promptness with which each one has performed his part.

In the submission of this brief report, I have the honor to subscribe myself,

Your Excellency's obedient servant,

ELLWOOD COOPER,
State Commissioner of Horticulture.

REPORT OF THE COMMISSIONER OF HORTICULTURE, FOR 1906.

OFFICE OF THE COMMISSIONER OF HORTICULTURE,
STATE CAPITOL,
SACRAMENTO, CAL., January 2, 1907.

To the Honorable Senate and Assembly of the State of California in Legislature assembled.

GENTLEMEN: In accordance with Section 10 of the law creating a State Commission of Horticulture, approved March 25, 1903, which provides that the Horticultural Commissioner shall report to the Governor in each even-numbered year and to the Legislature in each odd-numbered year, I have the honor herewith to submit my second biennial report to your honorable body.

THE MEXICAN ORANGE-MAGGOT.

There has been, in the past, considerable uneasiness on the part of growers of citrus fruits in the State, regarding the Mexican orange-worm (*Trypeta ludens*), which was reported as being a very serious pest in our sister republic, and which, it was feared, might be introduced into the orange orchards of California. To prevent this a quarantine was placed upon the citrus products coming from Mexico, and any such brought into the State were destroyed. As a result of this action, it was feared by the Mexican Government that the Federal Government would take like measures and prohibit the importation of Mexican oranges into the United States. This led to a voluminous correspondence between the Secretary of the Department of Fomento, in Mexico, the Secretary of State at Washington, and the Horticultural Commission of this State, culminating finally in the request of the Mexican Government that an agent be sent from California to investigate the spread of the orange-maggot in Mexico, the districts infested thereby, the amount of damage done, and the probability of its introduction into California, or elsewhere in the United States.

In accordance with this request, and under instructions from Governor Pardee, an agent of this department was dispatched to Mexico with full instructions to carry on investigations along the lines mentioned. To this end, the Mexican Government lent every possible assistance, and, as a result, we now have full information of the dangers to be apprehended from the introduction of this pest. This has already been published in a bulletin issued by this department, and generally distributed among the fruit-growers of the State.

From the period of the visit of our representative, the Mexican Government has kept its agents at work in the infested sections, gathering all fruit containing worms, which has been destroyed, cleaning out places where the worms could find refuge to go through their transformations, and taking every other possible measure to eradicate the pest. Weekly reports of this work have been forwarded by the Mexican authorities to this office, to indicate the efforts that are being made. As a result of this work, the citrus fruit-growers of California have the fullest assurance of protection from the introduction of this dreaded pest.

INTRODUCTION OF BENEFICIAL INSECTS.

The last Legislature made an appropriation of $12,000 for the purpose of prosecuting the search for beneficial insects. With this appropriation we have continued to work, keeping our agent, Mr. George Compere, in the field, and very many new and beneficial species have been introduced into our State. We have been very much hampered in this work, however, by the wording of the act, and the construction placed upon it by the Attorney-General, as it states explicitly that the appropriation shall be for the purpose of searching for beneficial insects, although we have required facilities for breeding, propagating, and distributing them after they have been received. Under the ruling of the Attorney-General we have been unable to use any portion of the appropriation for these purposes, and have been obliged to draw upon our general fund to meet the expense thereof, and this has greatly crippled the work in our other departments.

CODLING-MOTH PARASITE.

The parasite (*Caliephialtes messer*) introduced some time since to work upon the codling-moth has received a great deal of attention and has been bred out in large quantities and established in many of the more important apple sections of the State. Reports which have been received from sections where it has been established are to the effect that it is evidently doing good work, and that there has been a material reduction in the quantity of wormy apples during the past season. We have experienced much difficulty in getting sufficient larvæ of the codling-moth upon which to breed these insects, as each female fly lays from one hundred and fifty to two hundred eggs and deposits but one egg in a worm. It is therefore necessary that we should have nearly two hundred worms for each fly. We have found it very difficult to meet these requirements, and as a result have not been able to distribute the parasite as widely as we otherwise could have done. From our experience with this parasite, however, we believe that, if sufficient worms could be secured, we could readily breed them by millions during the season. Its prolificacy indicates the value of this parasite, as unquestionably in the open it will find its own food supply and multiply in large numbers.

We would call attention to a report on this insect, with colored plate, given elsewhere in this volume.

ASSISTANCE FROM COUNTY HORTICULTURAL COMMISSIONERS.

It is with pleasure that I acknowledge the hearty coöperation of the Horticultural Commissioners of the different counties of the State. The gentlemen comprising these boards have coöperated enthusiastically with this department, and I am under many obligations to them for assistance in our work. Elsewhere are given the reports of many of the county boards, in which allusions to the work of introduced parasites are made.

While treating of the subject of beneficial insects I may safely state that we have now beneficial insects to cope with all the injurious species in the State. It must not be supposed, however, that any injurious insects once introduced will ever be eradicated. All that we can do is to keep them in check to a greater or less extent, and this we are accomplishing by the introduction of beneficial insects. Our worst pests at present are the purple scale and the red scale, for both of which we have parasites now at work, but which are not sufficiently effective to be really valuable. We are, however, introducing others which will unquestionably check the spread of these two pests.

INSECTARY DESTROYED BY EARTHQUAKE.

In the great cataclysm which overtook San Francisco on April 18, 1906, this department did not wholly escape. Our insectary at the time was located in the Ferry Building, at San Francisco, and while this building escaped the fire, it was very badly shaken by the earthquake. The room in which our breeding cases were kept and the beneficial insects were propagated was badly damaged, the walls falling upon the breeding cases and making a general wreck thereof. A great many of our beneficial insects were lost, together with the greater part of our breeding appliances. We gathered what we could from the wreck and removed them to Sacramento, where a temporary insectary has been established. This has been placed in charge of a competent man, and we have now recovered from the loss sustained in San Francisco. During the past summer a great many beneficial insects have been produced therein and distributed to different portions of the State from which pests have been reported. We have, however, been very greatly inconvenienced in this work by our limited quarters and insufficient accommodations.

QUARANTINE AGAINST INFESTED NURSERY STOCK.

Word was received in this office in the early part of 1906, indicating that the white fly (*Aleyrodes citri*) had become a very serious pest on citrus and other stock in Florida, Mississippi, Louisiana, and other parts of the South. This is one of the most serious pests which the citrus fruit-growers of Florida and Louisiana have to contend against, rendering the production of this fruit unprofitable and almost impossible in locations where the fly has become thoroughly established. This fly does not confine its depredations to citrus fruits alone, but extends to many deciduous varieties, and even to ornamental shrubbery. In order to protect California from the inroads of this pest, a quarantine was established by this department against the states of Florida, Louisiana, and Mississippi, and nursery stocks and plants from these states have been barred from entrance into California.

PROTECTION AGAINST THE GYPSY AND BROWN-TAIL MOTHS.

In view of the spread of the brown-tail moth and the gypsy-moth in Massachusetts and other Eastern states, voluminous correspondence has been carried on between this department and entomologists in those sections, with a view to ascertaining the possible danger of importing these serious pests into California. At the present time the danger to be apprehended from this source is remote, but it is ever present.

I am pleased to note that the authorities of Massachusetts, in conjunction with the Entomological Bureau at Washington, have taken up the policy of fighting both of these pests with their natural enemies. Every known artificial means to destroy them has been resorted to for many years, but in spite of this they have steadily spread and the damage done by them has been enormous. It is to be hoped that the authorities there have now started in the right direction, and that the ravages of these pests may be checked.

California is especially interested in this work, as there is always a possibility, where pests of any kind exist in enormous numbers, of their introduction into our own State, and it is, in the estimation of this department, the better policy to have them controlled, and thereby prevent their entrance into the State, than to have to do the work after they have been admitted. It is for this reason that I am pleased to call your attention to the work now being done against these terrible pests in Massachusetts.

WORK OF THE QUARANTINE DEPARTMENT.

The quarantine department of this Commission has been kept up to its usual high standard during the past year. Every vessel coming into the different ports of California has been thoroughly inspected and all plants, trees, shrubs, cuttings, etc., have been examined before being allowed to pass. If any of these were found infested with insect pests or diseases not prevailing in California they were invariably destroyed, only clean stock being admitted.

It is very difficult to estimate the value of the work so done. While we may form some idea of the damage suffered from an insect pest when once introduced and established, it is impossible to estimate what has been saved by preventing the entry of such pests. At the port of San Francisco there have been stopped hundreds of new destructive insects, any one of which, if once established in our State, might have proved as serious and costly a pest as the cottony-cushion scale in the past, or as the gypsy-moth and the brown-tail moth in Massachusetts at present. The work of this department is steadily increasing, and new demands are continually being made upon those having it in charge.

STATE FAIR EXHIBIT.

In this connection I wish to allude to the very excellent entomological exhibit made by this department at our last State Fair. At the request of Mr. Filcher, Secretary of the State Agricultural Society, an exhibit was prepared by this office and installed in the exposition building at Sacramento. It comprised a large number of different species of insects from all parts of the world, all of which were mounted and displayed in the most attractive form. In addition to this, a number of breeding cases of beneficial insects, illustrating their work, were also shown. The exhibit was visited by several thousand people, and a great deal of interest was manifested. It was pronounced by competent judges to be the most valuable educational feature of the State Fair.

PUBLICATIONS ISSUED.

During the past year a number of very valuable publications have been issued from this department, including a number of monthly bulletins which dealt with horticultural matters of direct interest to the Horticultural Commissioners and fruit-growers of the State.

There has been a very heavy increase in the volume of correspondence during the past year, and knowledge of the work being done by the department is becoming more widely spread over the whole State, and, in fact, over the United States. We are constantly in receipt of specimens of insects, plant diseases, etc., for identification and for remedies. These all receive prompt attention. Correspondence has also been carried on with the various entomological societies and State institutions, and has reached out to very many foreign nations, all of whom are taking an especial interest in our work.

California is to be congratulated upon the fact that she is the pioneer in the work of fighting insect pests with their natural enemies. For years we have stood alone in this work, but our example is now being followed by very many states and territories and by foreign nations, and this State is looked to as the great exemplar in this work. It is true that the good work done by predaceous and parasitic insects has been known for a great many years, but it remained for California to give a practical turn to the work, and introduce beneficial insects for work upon the destructive species.

FINANCIAL STATEMENTS.

I append hereto the financial report of my office for the fifty-sixth and fifty-seventh fiscal years.

Following is a report of the expenditures of this department for the fifty-sixth fiscal year:

Library, books, papers, and periodicals	$42 60
Engravings, lithographs, etc., for Biennial Report	574 00
Extra help	208 50
Expenses of agent for nursery inspection	98 70
Express	162 89
Freight and cartage	17 30
Fruit-Growers' Convention	148 60
Furniture	14 35
Fumigation apparatus	55 50
Insect work, supplies, parasitic food, etc.	67 25
Janitors	240 00
Miscellaneous	240 82
Morellos orange-maggot investigation	609 65
Microscopic supplies and chemicals	91 89
Postage	581 13
Reporting vessels	180 00
Salary of inspector at San Francisco	1,475 00
Salary of foreign expert	1,200 00
Salary of stenographer	625 00
Traveling expenses of Commissioner	518 01
Traveling expenses of Deputy Commissioner	145 20
Traveling expenses of Secretary	124 15
Traveling expenses of Inspector	48 45
Telephones and telegrams	193 76
Translations	35 00
West Australian Government	1,640 22
Total	$9,341 57

Appropriation fifty-sixth fiscal year	$7,000 00
Balance of appropriation fifty-fifth fiscal year	2,266 77
	$9,266 77
Stamps sold and money credited to appropriation	74 80
Total amount available during fifty-sixth fiscal year	$9,341 57
Expenditures fifty-sixth fiscal year	9,341 57

Following is a statement of the expenditures of this department for the fifty-seventh fiscal year:

Library, books, papers, etc.	$35 75
Express	115 74
Extra help	53 00
Freight and cartage	32 10
Fruit-Growers' Convention	110 70
Furniture	32 45
Janitors	315 00
Insectary	292 97
Insect work, food, supplies, etc.	204 46
Miscellaneous	223 87
Microscopic supplies and chemicals	77 30
Rent of rooms in San Francisco	320 00
Reporting vessels	150 00
Postage	5 00
Salary of Inspector, San Francisco	1,500 00
Salary of Assistant, San Francisco	1,200 00
Salary of stenographer	900 00
Traveling expenses of Commissioner	455 19
Traveling expenses of Deputy Commissioner	145 55
Traveling expenses of Secretary	111 20
Traveling expenses of Inspector	78 90
Traveling expenses of Assistant	35 00
Telephones and telegrams	216 09
Total	$6,610 27

Following is a report of the expenditures incurred under the appropriation of $12,000 for the search for beneficial insects for the fifty-seventh fiscal year:

Salary of George Compere for 12 months (July 1, 1905, to June 30, 1906)	$1,200 00
Expenses of George Compere (July 1, 1905, to January 31, 1906)	1,122 07
Total	$2,322 07

The above is only a partial statement of expense, as the account from the West Australian Government, with whom we share the expense, has not been rendered for 1906.

Respectfully submitted.

ELLWOOD COOPER,
State Horticultural Commissioner.

REPORTS OF DEPUTY COMMISSIONER OF HORTICULTURE.

San Francisco, December 30, 1905.

To Hon. Ellwood Cooper,
State Commissioner of Horticulture.

Dear Sir: I have the honor to submit to you herewith my report of the work done at the Quarantine Division at San Francisco, covering the period from July 1, 1904, to December 31, 1905.

During this period there have come under our supervision 385 steamers and sailing vessels arriving from foreign countries and our insular possessions, Hawaii and the Philippine Islands, on which were found plants and fruits.

The shipments of plants, fruits, and vegetables on these steamships and sailing vessels, and also by rail overland from the Eastern states and Europe, consisted of the following: Crates and boxes, 48,032; cases of plants by water, 2,100; cases of plants by rail, 113; loose lots of plants by passengers, 757; lots destroyed, 250.

Among the above shipments of trees, fruits, plants, and vegetables from the various countries, as shown by the table below, the lots given were found to be seriously infested with destructive insect pests, and were destroyed.

Country.	Plants.	Fruits.	Country.	Plants	Fruits.
Mexico	10	62	China	24	16
Hawaiian Islands also 1 lot of vegetables	6	19	British Columbia		22
Australia	12	7	Philippine Islands	7	
Central America	10	12	Tahiti	35	16

The shipments of this year, when compared with those of 1903–4, show a great increase in all lines coming under our surveillance.

A strict quarantine is maintained on all citrus stock from Florida, against the possible introduction of the dreaded "white fly" (*Aleyrodes citri*). We are in receipt of advices that this pest has spread to adjoining states, and it may become necessary to quarantine against other Southern states as well, in order to protect our citrus industry.

On April 11 there arrived per steamer "Alameda," from Honolulu, a shipment of cucumbers that were found to be infested with maggots of the melon-fly, a very serious pest attacking all kinds of melons, cucumbers, tomatoes, etc. The shipment was promptly destroyed.

REPORT ON WORK IN INSECTARY.

From the various colonies of parasites distributed by this department we have received many very encouraging reports, showing that they have become established. This is especially true of the parasite for the codling-moth, from which we anticipate great results.

There have been received by this department from Mr. George Compere the following shipments of beneficial insects during the time covered by this report:

October 17—A shipment of predaceous Coccinellidæ that prey upon the "red scale" (*Chrysomphalus aurantii*), from Jaffa, Palestine. Identified as *Chilocorus bipustulatus*.

October 25—A shipment of *Caliephialtes messer*, the parasite for the codling-moth, from Spain.

October 25—A shipment of Chalcid flies, parasitic upon *Pieris rapæ* (cabbage-worm). These were reared and liberated near Glendora, Cal.

October 26—A shipment of predaceous Coccinellidæ from south of France and Spain consisting of the following species: *Adalia bipunctata*, *Chilocorus bipustulatus*, *Adalia congloblata*, *Exochomus 4-pustulatus*, *Scymnus* sp., which prey upon red scale, greedy scale, Aphis sp., and others, being general scale-feeders.

November 2—A large shipment of *Caliephialtes messer*, parasite for the codling-moth.

November 15—A lot consisting of four packages of *Caliephialtes messer*, parasite for the codling-moth.

November 23—A lot consisting of five boxes of *Caliephialtes messer*, and additional Coccinellidæ.

December 1—A lot of *Caliephialtes messer* and a smaller Chalcid parasite which works on the pupæ of the codling-moth.

December 28—A lot of 10 boxes of the Ichneumon parasite for the codling-moth and additional Coccinellidæ of the above-named species.

January 10—A lot consisting of fourteen boxes of the codling-moth parasite. This is the largest shipment of parasites ever sent into this State.

April 15—From Bahia, Brazil, a small lot of minute Coccinellidæ which feed upon red spider. Unfortunately these insects did not survive the long voyage, and arrived dead.

September 28—From Hongkong, China, two small orange trees infested with purple scale, showing signs of internal parasites. These have been placed in breeding cases and every effort is being made to rear the parasites.

September 29—From German New Guinea, the following: A shipment of predaceous Coccinellidæ (*Cryptolæmus subviolaceus*), which prey upon the mealy-bug (*Pseudococcus* sp.); also, another species of *Vedalia*, which preys upon *Icerya ægyptica*, a near relative of our cottony-cushion scale; also, pupæ of *Thalpochares* sp., a moth which preys on *Eulecanium nigrum*.

October 28—From China, five cases and two packages of orange, shaddock, sago palms, and other plants infested with red and purple scales, and containing the eggs of the internal parasites for the two scales above mentioned.

Reports from the various sections into which parasites have been sent show that they have been doing excellent work, and the increased demand for colonies is ample proof that the growers approve of our system of fighting insect pests with their natural enemies.

INSECT PESTS AND DISEASES.

The record of our observations and of the various reports received during 1905 of injurious insects and plant diseases are as follows:

Plant Lice.—Owing to the cool moist season, aphids have been rather plentiful; especially is this true of the apple-aphis (*A. mali*), the prune-aphis (*A. prunifoliæ*) on young trees, the melon-aphis (*A. cucumeris*), and the hop-aphis (*Phorodon humuli*).

Cutworms.—Reports from various sections of the State, asking advice in regard to damage done by cutworms, were very numerous, and announce the fact that this pest was again plentiful. As stated last year, the sudden destruction of weeds, their natural food, always forces a severe attack on young trees and vines while this pest is in the larval stage.

Grasshoppers.—This pest was again reported from various sections, and for a time caused considerable alarm in the vicinity of orchards and vineyards. Good work was done by the use of poison baits before the winged form appeared.

Codling-Moth (*Carpocapsa pomonella*).—Reports from nearly all the apple and pear sections indicate a material decrease of this pest, probably due to climatic conditions; and from our own observations this is greatly verified. I might state that it has been a hard task to procure worms for the breeding of the imported parasites (*Caliephialtes messer*). Wherever this parasite has been liberated, satisfactory reports have been received and our own observations have shown that the parasite has become established; in fact, in several instances the third and fourth generations have been found. Owing to the abnormal season of 1905 and the scarcity of worms it has proved an unfavorable season for the rapid increase of the parasite.

Peach-Moth (*Anarsia lineatella*).—According to reports this pest has been more plentiful. Our observations of the worms in the fruit in the market and in that from Honolulu which has been rejected verify these reports.

Vine Flea-Beetle (*Adoxus vitis*).—In July complaints of a severe attack on vines by this pest reached this office. Although this insect can do considerable damage in favorable seasons, such as 1905 was, complaints of its occurrence in this State are not very numerous. In Europe this beetle is a very serious pest.

Other Flea-Beetles (*Haltica bimarginata* and *H. torquata*).—Serious damage to beans, potatoes, and other vegetables was reported—too late to get much benefit from insecticides, which was very unfortunate, as much good can be accomplished when the pest first makes its appearance.

Fuller's Rose-Beetle (*Aramigus fulleri*).—The damage done by this beetle every year amounts to a great deal more than reports generally indicate, and strangest of all, the insect, not being able to fly, seems to spread quite rapidly. This insect is also very destructive in the larva form, as it attacks the roots of various plants.

Thrips (*Euthrips pyri*).—This insect has caused considerable correspondence, on account of the very serious damage done to fruit blossoms. It has been reported from several counties, but the most damage is recorded from Santa Clara County.

Scale Insects (*Coccidæ*).—Generally speaking, there is a great reduction in scale insects throughout the State, partly due to a vigorous campaign with sprays and fumigation outfits, and partly to the efficient work of parasites.

Black Scale (*Saissetia oleæ*).—This scale at the season's opening looked threatening and discouraging. Its parasite, *Scutellista cyanea*, owing to the prolonged cold spring weather, was not much in evidence, but as soon as warmer weather prevailed the *Scutellista* appeared by millions, and in sections where it was not abundant they were at once reinforced with strong colonies from this office.

Brown Apricot Scale (*Eulecanium armeniacum*).—This species was not as abundant as last year, although in some of the upper counties quite a demand was made for its parasite, *Comys fusca*.

Red Scale (*Chrysomphalus aurantii*).—This species has been vigorously fought during the past year by fumigation and spraying, and as far as recorded has not increased to any great extent.

Purple Scale (*Lepidosaphes beckii*).—This species has been on the increase in San Diego and Orange counties during the past two years, owing to the unsettled condition of the County Horticultural Boards, but I am pleased to report that during the latter part of 1905 the County Boards have been reorganized and a vigorous campaign has been inaugurated against this serious pest and good work in eradication is being done by fumigation.

Soft Tulip Scale (*Eulecanium tulipiferæ*).—During the year several cherry branches infested with this scale were brought to this office. Not having any record of its presence in California, the orchard was at once visited to ascertain conditions. From the quantity found and the general spread—finding it not only on the cherry, but also on peach, apricot, and prune—this insect must have been in the locality for several years. The scale is a great pest in the Eastern states on linden trees and other ornamental shrubbery.

Cottony-Cushion Scale (*Icerya purchasi*).—This scale has been so completely held in subjection by the *Vedalia cardinalis* that it has been very difficult to secure enough material to keep our breeding cages supplied with the necessary food for the propagation of this valuable ladybird.

Yellow Scale (*Chrysomphalus aurantii citrinus*).—Numerous applications for parasites on this scale have been sent into this office from the northern section of the State. On examination of specimens submitted to us, evidence of the parasite was found, and we believe that climatic conditions, which have proved unfavorable for the parasite, are probably responsible for the slight increase of the scale.

Mites.—The yellow mite (*Bryobia* sp.) was very abundant again in the interior valleys. The extreme summer heat seems to be favorable for an enormous increase of this pest, which attacks almost all growth. Much damage is done to peanuts, beans, and all orchard trees, as well as the willow and sycamore. The almond mite (*Bryobia pratensis*) was abundant in the upper valleys. The pear-leaf blister mite (*Phytoptus pyri*) was so abundant in some sections as to cause inquiry about its being pear blight. The grape-leaf mite (*Eriophyes vitis*) was reported during the season from several of the grape sections as causing considerable damage by producing an erineum on the under surface of the leaves, causing large swellings on the upper surface. A similar trouble was also reported on walnut, which is caused by another species, probably *Eriophyes tristriatus*. By the application of dry sulphur these two species have been readily destroyed.

Red Spiders (*Tetranychus mytilaspidis*, *T. sexmaculatus*, and *Tenuipalpus californicus*).—These species, affecting the citrus trees principally, have not been as numerous in 1905 as they were in previous years. Owing to the fact that distillate sprays have been extensively used, no doubt accounts for the marked decrease of these species.

Fungi.—Owing to favorable climatic conditions (a warm moist spring), the more common fungi, such as shot-hole fungus, peach curl, pear scab, peach and apple mildew, onion blight, potato blight, and scab, were very abundant and occasioned much inquiry and correspondence. In the Sacramento and San Joaquin valleys the peach was attacked by a species of fungus (*Coryneum beyerinkii*) and much damage was done. The apricot crop in other sections was badly damaged by shot-hole fungus, and the market was full of very inferior fruit.

Respectfully submitted.

EDW. M. EHRHORN,
Deputy Commissioner of Horticulture.

SAN FRANCISCO, November 1, 1906.

To HON. ELLWOOD COOPER,
State Commissioner of Horticulture.

DEAR SIR: I have the honor to submit to you herewith my annual report as Deputy State Commissioner of Horticulture, embracing the important duties of the Horticultural Quarantine Division.

During the period from January 1, 1906, to November 1, 1906, there arrived at the port of San Francisco 217 passenger steamers and a few sailing vessels from foreign countries, and which required our attention, as most of them carried passengers and were liable to carry fruits and plants. Of all vessels inspected, we found that about 18 per cent arrived without fruit or plants, being mostly slow freighters which carry a few passengers, but owing to slow travel seldom carry perishable goods; 47 per cent of these vessels contained fruit and plants, which were fumigated and passed; and 35 per cent contained fruits and plants, some of which were destroyed and some refused landing.

The following shipments under date will be of more than ordinary interest and merely represent some of the many instances in the quarantine work:

January 9th, on the steamer "Newport," in the passengers' baggage, we found three lots of oranges, three lots of sweet limes, and a few pomeloes which came from Mexican ports. As these were liable to contain the Morellos orange-maggot (*Trypeta ludens*), they were destroyed.

January 14th, on board the transport "Sherman," we found three flowering cherry trees infested with *Erioccocus azalea* and seven camellias badly infested with *Pseudaonidia duplex.* Both being dangerous pests, the plants were destroyed.

January 15th, the steamer "Sierra" brought by freight from Honolulu, thirteen cases of tomatoes infested with the larvæ of the melon-fly (*Dacus cucurbitæ*). The whole shipment was destroyed and notice given the shipper not to send any more tomatoes to California. In one tomato we found seventy-nine maggots. This is the most destructive pest on cucurbits in the tropics and would play havoc with many of our vegetables, if it ever got a foothold in our State.

January 26th, on the steamer "Mongolia," a passenger brought two flowering cherry trees and a dwarf maple infested with *Aulacaspis pentagona*, the East India peach scale; another passenger brought two palms infested with an *Aleyrodes* species. All these plants were promptly destroyed. *Aulacaspis pentagona* has proved to be the most destructive scale insect of the peach in other countries, and the importance of a strict quarantine against it is quite necessary.

March 1st, on board the steamer "Curacao," from Mexico, we found one box of oranges and sweet limes which were badly infested with *Chrysomphalus aurantii;* in fact, some of the fruit was completely covered with the scale. Among the oranges we found a few containing the larvæ of a fruit-fly, and destroyed the whole shipment.

March 10th, on the German steamer "Sesostris," from Central American ports, we found five cocoanut palms badly infested with *Pseudococcus nipæ*, one of the most serious mealy-bugs known.

March 19th, on the steamer "Coptic," from the Orient, we found in possession of the crew two Biotas badly infested with an aphis, which were so numerous as to cover the trunk of the plant completely. This is apparently a very prolific species. We promptly destroyed the plants.

April 6th, the steamer "America Maru" brought two cases of plants by freight, which were fumigated and overhauled. One third of the plants were destroyed, on account of being infested with the following scale insects: *Ceroplastes* sp., *Antonina crawii*, *Leucaspis japonica*, and *Aulacaspis pentagona*.

April 13th, on the steamer "Mongolia," from the Orient, passengers had in their possession five lots of oranges infested with *Parlatoria* *ziziphus*, four flowering cherry trees and two other plants infested with *Aulacaspis pentagona*, which were destroyed.

May 14th, on the steamer "Mariposa," from Tahiti, we found in possession of one of the crew two cocoanut palms infested with several species of scale insects.

May 15th, in the United States postoffice, we inspected two packages of plants from Japan, out of which eight plants were destroyed, on account of being infested with scale insects. The postoffice authorities always notify us of the arrival of plants by mail.

June 7th, on the steamer "Coptic," from the Orient, we found six flowering cherry trees infested with *Aulacaspis pentagona*, also a lot of oranges badly infested with *Parlatoria ziziphus*.

June 10th, a passenger on the steamer "Queen," from British Columbia, had among his clothing a lot of oranges from the Fiji Islands, badly infested with *Parlatoria* sp., *Aspidiotus* sp., and *Chionaspis* sp.

July 18th, on the steamer "Alameda," three cases of mangoes infested with *Phenacaspis eugeniæ*. Judging from the appearance of this lot of fruit this insect would prove a serious pest if allowed to land in this State.

July 24th, on the steamer "Doric," from the Orient, we found five lots of mangoes and a bunch of mango cuttings infested with *Phenacaspis eugeniæ*, and some Leit-Chees infested with a *Eulecanium* sp. and an *Odonaspis* sp.

July 30th, on the steamer "Sonoma," a passenger had some oranges and apples from Sydney, and owing to the danger of fruit-flies these were destroyed. We also found some fruit packed in grass which was infested with *Odonaspis ruthæ*, a destructive grass pest. On the same steamer six boxes of alligator pears had to be overhauled, as we found leaves and twigs packed in with the fruit, and these were infested with *Pseudococcus nipæ*. The steamer also brought 900 boxes of lemons from New Zealand, which were badly infested with a fungous growth and scale insects. These were not allowed to land in the State.

August 14th, on the steamer "Ventura," a lady had a box of plants from Honolulu, which she received from the Commission of Agriculture and Forestry. Among the lot were seven plants badly infested with *Pseudococcus nipæ*, which were destroyed.

September 3d, on the steamer "Sierra," from Honolulu, we found twelve wreaths in the passengers' baggage. As these were all made of Melei leaves, which are infested with *Ceroplastes rusci* and an *Aleyrodes* sp., we destroyed them.

September 4th, on the steamer "America Maru" we found four dwarf maple trees which were badly infested with *Parlatoria pergandii*.

September 29th, on the transport "Sherman" we found a pine tree containing the pupæ of a large sawfly (*Monoctenus* sp.) and two Solanum plants infested with a fungus and a *Eulecanium* sp.

October 11th, on the steamer "Doric" a passenger had a pomelo infested with no less than five different scale insects, which she was bringing as a curio to some interior town, and no doubt when the fruit would show decay the owner would have thrown it into some yard, possibly among growing plants. It was destroyed.

To give a clearer idea of the various shipments which arrived during the several months, the following table has been arranged.

All shipments of fruits and trees which arrived by rail from foreign countries and other states are also included:

Month—1906.	Number of Vessels.	Cases of Fruit.	Cases of Plants by Steamer.	Cases of Plants by Rail.	Loose Lots Passengers' Baggage.	Fruit or Plants Destroyed or Refused Entry.
January	22	4,494	77	16	155	45
February	18	4,472	73	23	60	34
March	26	15,687	16	12	150	26
April	22	11,446	4	28	109	17
May	20	6,623	21	3	78	19
June	20	2,483	31	....	109	11
July	20	3,004	....	....	98	928
August	23	4,249	6	....	182	75
September	22	2,591	92	....	154	25
October	24	2,362	705	2	113	23
Totals	217	57,411	1,025	84	1,208	1,203

As in the past, all trees, plants, and fruit infested with injurious insects or diseases new to the State have been destroyed. Occasionally we find a few oranges in the possession of passengers from Mexican ports, which, as noted above, are always destroyed. Despite the fact that the Morellos orange-worm (*Trypeta ludens*) does not exist in all parts of Mexico, we deem it wise and by far a safer plan to confiscate and destroy all this fruit. The maggot being in the fruit, it is difficult to detect it; and to make an examination, the fruit has to be cut open, which destroys it. As this pest does exist along the Mexican coast, we have reasonable cause to presume that the fruit might be infested. All employés on vessels from Mexican ports have been instructed not to bring oranges and sweet limes.

A great amount of time and labor is taken up in the fumigation of pineapples from Hawaii, which have found a good market in California, Oregon, and Washington, and very large shipments arrive during the season. Through the agencies of Wells, Fargo & Co., Morton Special Delivery, and others, a great amount of this fruit is shipped to individuals all over the State. As this fruit is always more or less infested with *Pseudococcus citri* and *Diaspis bromeliæ*, it is very important to guard against the spread of these pests. We have made special arrangements whereby this office is furnished with chemicals, labor, and other expenses required in the fumigation of the fruit.

We are greatly indebted to the U. S. Customs Bureau for the hearty coöperation and the very evident interest which they accord us in the furtherance of our duties, as without this material aid we would be greatly handicapped.

Respectfully submitted. EDW. M. EHRHORN,
Deputy Commissioner of Horticulture.

REVIEW OF THE FRUIT SEASON.

SEASON OF 1905.

Cherries.—The season of 1905 opened very promisingly for the cherry crop. The trees were heavily loaded with fruit buds and blossomed profusely early in the season. Excessively heavy rains, however, fell at the time the trees were in bloom, washing out the pollen and preventing the setting of the fruit. As a result, instead of the heavy crop that was expected, the cherry yield was one of the lightest known in our State for many years. There were but 79 carloads of cherries shipped to the Eastern market and the supply at the canneries fell so short that the lightest pack of cherries that has been put up for years was the result. In a few orchards, especially favored by location, fair crops were gathered, and the fruit from these brought almost fabulous prices. Shipments for 1904, which were also considered light, ran up to 209 cars, so that it will be understood from the comparison that the cherry crop of 1905 was a failure.

Apricots.—The apricot crop for the year 1905 was an unusually heavy one. It is a peculiarity of this fruit that we rarely have two good seasons together, and the crop of 1905 seemed in some way to make amends for the shortage of the cherry crop. It was, taken altogether, one of the best that has ever been gathered in the State, being above normal in quantity and yet average in quality. There were shipped of this fruit, in its fresh condition, 279 cars, the largest quantity ever reported from the State in any one season. Shipments were very active, good prices were obtained, and the cannery demand was heavy. In the section around Lodi, the crop ripened very early—from a week to ten days earlier than usual. In their anxiety to take advantage of the early market, some shippers packed and forwarded immature fruit, upon which losses were sustained, but, on the whole, good prices were realized.

Peaches.—In some of the peach sections of the State the peach blight made very serious inroads on the peach orchards and affected the total output very materially. Yet, on the whole, it may be said that the peach season of 1905 was an extraordinarily good one. The crop in most sections was heavy and brought generally good prices. Shipments were very largely in excess of those of any previous season, running up to 1,946 carloads, a number not equaled in any season since that of 1899. The greater part of this fruit was composed of the late varieties, the earlier kinds not turning out well, and it was feared early in the season that the crop would be light. The earlier shipments of peaches brought good prices in the Eastern market, but the later consignments came into contact with the Eastern fruit, and prices fell. There was a very active demand for peaches for canning purposes, and altogether the peach season may be summed up in the statement that the crop was good, the demand heavy, and prices all that could reasonably be expected.

Plums.—The plum crop on the whole was good, being somewhat in excess of former years. The shipments of this fruit were the largest ever known, with perhaps one exception, in the history of this fruit in the State. During the season there were 1,391 carloads of fresh fruit shipped to the Eastern markets. As a rule, the shipments brought very good prices. The cannery demand was equally good, and plum men enjoyed a prosperous season.

Pears.—Pear blight cut very largely into this fruit during the season of 1905, and added to this were the excessively heavy rains which fell during the blooming period, and as a result the pear crop, like the cherry crop, may be said to have been a failure, the total output being less than that of any year since 1895 and less than one half the crop of the preceding year. There were but 1,003 carloads of pears shipped out of the State during the year. Prices were phenomenally high, but even at the prices offered, the fruit could not be obtained. In view of the prices obtained for the fruit, it is probable that, despite the short crop, more money was received for pears during the season of 1905 than in any previous year. Quotations were made early in the season at $35 per ton and rapidly climbed up until reports were made of $60 to $65 being offered, with no fruit to supply the demand.

Apples.—The apple crop was a large one, one of the largest, in fact, that has been produced in the State. Owing to the care bestowed upon the orchards in the principal apple sections, the percentage of wormy fruit was greatly reduced, and the quality of the fruit as a whole very greatly improved. There were 1,208 carloads of apples shipped out of the State for 1905, as compared with 43 for 1904. This was the heaviest total shipment of apples ever made in one season from California. Prices during the greater part of the season ruled high, and on the whole were very satisfactory to the growers.

Prunes.—Early in the season the outlook for the prune crop was a very good one, and estimates rendered were generally to the effect that the output would be large. As the season advanced, however, conditions changed, and the reports indicated a continual shrinkage in the estimate, and by the time the crop was harvested it developed that the output was very far below normal. This was especially true in the Santa Clara Valley, the principal prune section of the State. In other parts the crop was better, but not sufficiently good to bring it up to normal. One of the great causes of the shortage was the presence in enormous numbers of a minute insect pest, the pear thrips (*Euthrips pyri*), which attacked the essential organs of the blossoms and prevented the pollenization of the fruit. A great deal of the fruit that remained was also attacked by this pest, being inferior in size and deformed in shape. Altogether, the prune season was a very unsatisfactory one, with prices equally unsatisfactory to the grower, owing to the poor quality of the fruit. The great shortage of prunes, however, had one beneficial result, as the market was cleared of hold-over stock and an open field left for the following crop at better prices.

Grapes.—The grape crop fell somewhat below normal in quantity, but still was a very fair one, the quality of the fruit compensating for the small shortage in the crop. There was a very hot spell during the early part of July of 1905, which very seriously cut into the crop, especially in the early districts, and reduced the total output, particularly in table grapes. Notwithstanding this fact, the shipments of table grapes were exceedingly heavy, running up to 1,602 carloads and overtopping the exports of 1904 by 150 carloads. The market was unusually active, the demand good and prices unusually high, and growers and shippers of table grapes netted very large returns on their crops.

Walnuts.—The walnut blight was very serious throughout the walnut orchards of Los Angeles and Orange counties, and did a great deal of damage during the season, cutting largely into the crop. It also extended its operations into new sections and appeared in Ventura and to some extent in Santa Barbara counties for the first time. Indications in the early part of the season were very promising for a good crop, but owing largely to the effects of the blight and unfavorable climatic conditions the crop fell very much short of early expectations. Shipments were very much lighter than usual, and the crop was not over sixty per cent of what was expected. A very large portion of the crop was also of poor quality, owing to the blight; but the poor nuts were carefully sorted out and only the best shipped to the Eastern market. Prices were good, but owing to the shortness of the yield the season can not be considered a favorable one for the walnut-growers.

Almonds.—Almonds gave better returns to the growers than did walnuts. The yield of orchards in San Joaquin and Alameda counties ranged from very fair to good. In the almond orchards of Yolo and Solano counties the red spider appeared in large numbers during July and August and somewhat reduced the crop and lowered the quality of the nuts. With all this, taking the State at large, the almond crop of 1905 may be considered as a good one. The growers received very fair prices for their fruit, and have generally done well with their crops.

SEASON OF 1906.

Cherries.—The early cherry season opened with great promise for the growers, and there was every prospect that the crop would be an exceedingly heavy one. Trees blossomed freely and the young fruit set heavily. Late rains and high winds in many of the cherry sections, however, did great damage to the crop and there was a very heavy falling off of the early varieties. In consequence, the shipments of early cherries were light, but the later varieties brought the crop up to above normal. The latter yielded very heavily, and late in the season the Eastern shipments were very large. As a rule, the shipments commanded good money, and cherry-growers had a good season. The shipments for the season totaled 149½ carloads, against 79½ for the previous year. There was a very heavy demand for cherries, too, on the part of the canneries, and an unusually large pack of this fruit was put up.

Apricots.—This was a decidedly off season for apricots, and the yield of this fruit was so light that it may be said to have been a total failure, the entire output of the State not reaching over fifteen per cent of the normal. There were altogether 16¼ carloads shipped to the Eastern markets, against 278½ for the previous year. The canneries had contracts for a large portion of the crop and the greater part of it went to these institutions. Very high prices prevailed and dried apricots reached 15 cents, the highest price for many years past.

Peaches.—Owing to the heavy rains and moist weather of the late winter and early spring months, the peach blight got a strong foothold in the principal peach sections of the State and very much damage was done thereby. This disease affected the bearing wood of the trees and very largely curtailed the crop. In addition, there were severe winds and heavy rains during the blooming period, the blossoms were not pollinated and the set was very light. As a result, the peach crop of the State this year fell very much below normal, as indicated in the total shipment of 583¼ cars against 1,945¾ for 1905.

As indicating the destructive work of the peach blight where it obtained a foothold, it may be noted that in sections where the blight had not made its appearance the yield was normal. The late fruit was less seriously affected than the early varieties, and the shipments consisted almost entirely of late peaches.

The earlier shipments to the Eastern markets brought very good returns, but later in the season our fruit came into conflict with the Georgia, Michigan, and other Eastern-grown fruits, and the market price dropped materially. The home demand was very active, and canneries offered from $50 to $60 per ton for clings. Altogether the season of 1906 may be designated as an unfortunate one for the growers.

Plums.—This crop was very nearly normal and the yield generally good. The shipments fell below those of the preceding year, being 1,220½ cars against 1,391¼ for 1905. The slight reduction in amount, however, was more than compensated for by the increase in price, and the greater part of this fruit reached the Eastern market in excellent condition, bringing the shippers good returns.

Prunes.—Some little complaint has been made of the shortage in some sections of the Santa Clara Valley, but generally the prune crop turned out well there, also in all other prune sections of the State, and will be at least normal. The work of gathering is now finished, drying and processing are being completed, and reports from all sections are to the effect that there is a full average crop, ranging probably to 180,000,000 pounds.

The crop of 1905 was very seriously damaged by an attack of the pear thrips, but these did not show up in such numbers in the spring of 1906, and very little damage is reported from their attacks this season. Prices have very materially advanced, and as the foreign prune crop is very light, and the demand for this fruit is increasing, there is every prospect that the growers will get good figures for their stock. They are now holding at a 3½-cents base.

Pears.—In spite of the ravages of the pear blight, which has been reported from several new sections, and which has done a great deal of damage wherever it has obtained a foothold, there has been a very large increase in the pear crop of 1906 over that of 1905, shipments being 1,511½ cars against 1,011½, leaving a balance to the credit of 1906 of 500 cars over 1905. Besides this there was a very much heavier pack of pears at the canneries and unusually good prices were paid to the growers. There has been a very determined fight in the pear districts against the inroads of the pear blight. In the sections where it has not appeared, every effort has been made to prevent its entrance, and so far with very good promise of success. Where the blight had not appeared this year, the crop was a very heavy one.

Apples.—Reports from the apple sections indicate that the crop of this fruit has been normal this year and the quality of the fruit exceptionally good. There has been a very marked decrease in wormy fruit, and this condition is reported from nearly all parts of the State. This is probably due to a number of causes: an unfavorable season for the codling-moth, unusual efforts on the part of the growers in watching for and fighting the pest, the introduction and work of the parasite, and various other causes. It is matter for congratulation on the part of all our apple-growers that this most serious of pests appears to be decreasing, and it is to be hoped that by the combined efforts of all the causes, we may yet succeed in keeping it in check to a great extent.

At the present writing the apple-shipping season is on, and this fruit is going forward steadily in carload lots. There have been shipped the present season up to date 511¾ carloads, against 1,208 carloads for last season. No comparison can be made between the two seasons, however, as active shipments will continue for some time yet, and the exports will probably equal if not exceed those of last year.

Grapes.—The grape crop was somewhat lighter than that of 1905, but prices, which were excellent for that year, were twenty-five per cent higher for the present season, and the quality was very much better than that of 1905. The shipments also have been heavier, there being 1,984 carloads shipped during the present season as against 1,556¼ during the last. The demand for table grapes in the East is a steadily growing one, and prices are increasing with each year. In this State very large new areas are being planted constantly to table grapes, and there is little question but that this will become one of the most important and profiable in the list of our horticultural industries.

The principal cause of the slight shortage in the grape crop was due to the very hot spell during the early part of July, which burned a great many grapes on the vines where they were exposed to the direct rays of the sun. While the crop was somewhat light, there was sufficient new acreage coming into bearing to compensate for the shortage, as is indicated by the increased shipments.

Walnuts.—The walnut crop, which fell somewhat below normal in 1905, increased to very nearly the normal output in 1906, being about twenty per cent heavier than that of last year. The larger part of the crop has already been shipped, 850 carloads having been sent out of the State. Prices have been very fair, ranging up to 12½ cents, and the demand has been good. Grave fears had been expressed in regard to the spread of the walnut blight, but this disease seems to have been checked during the past season, and while it existed in destructive force in some orchards, yet it did not spread to any extent and was not nearly so serious even in those sections where it had become firmly fixed.

Almonds.—The almond crop of 1906 has been fair to good, very many of the orchardists reporting heavy crops. In some instances the yield was light, but, taking it altogether, the crop has been normal. The red spider was reported in some of the orchards, but was not so serious a pest as it was the preceding year. The nuts, as a rule, have been well filled out, and have commanded good prices for the grower.

FRUIT SHIPMENTS—1905 AND 1906.

Following is a comparative statement of the shipments of fruit out of the State during the past two years:

	1905—Cars.	1906—Cars.
Cherries	79¼	149½
Apricots	278½	16¼
Peaches	1,945¾	583¼
Plums	1,391¼	1,220½
Pears	1,011½	1,511½
Grapes	1,556¼	1,984
Apples	1,208	511¾
Tomatoes	¼	3
Figs	----	1¼
Quinces	13½	14¾
Cantaloupes	----	¾
Persimmons	1¾	1
Totals	7,486	5,998

ENTOMOLOGICAL.

Entomology in Outline.
The Coccidae of California.
Insects of the Year.
Parasite of the Codling-Moth.
Gypsy and Brown-tail Moths.
Peach Blight.

ACKNOWLEDGMENT.

To P. Blakiston's Sons & Co., Philadelphia, we are indebted for the use of the cuts numbered below, which appeared in the excellent work by Professor J. W. Folsom, entitled "Entomology, with Special Reference to its Biological and Economic Aspects": Cuts numbered Fig. 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 38, 41, 56, 57, 59, 60, 68, 80, 84, 87, 110.

UNIV
OF
CALIFORN

ENTOMOLOGY IN OUTLINE.

Arranged for Horticultural Commissioners, Fruit-Growers, and Farmers.

By JOHN ISAAC.

Some simple work, which shall present, in plain, every-day language, information about the insect world, has long been desired by our County Horticultural Commissioners and fruit-growers. As a rule, these men are not scientific entomologists, nor do they need be, but, at the same time, it is necessary that they should know something of insects and their modes of living, and be able to distinguish between insect friends and enemies, in order that they may protect the one and destroy the other.

It is much to be able to tell to what order an insect belongs, more to know to what family in that order it belongs, and this is as far as the average commissioner or orchardist can hope to go; to go farther and trace it to genera and species is the work of the trained entomologist, and is a life work alone for any man.

It is the desire of the writer to place such knowledge before his readers, in the simplest manner, divested as far as possible of all scientific and technical terms. Those who desire more can acquire it from the scientific text-books. We do not offer this as a scientific dissertation on entomology, nor as giving, by any means, all that is known of that science, but simply as an introduction to every-day men of the more general facts which they should know in the pursuit of their calling for the benefit of their constituents.

SYSTEM IN NATURE.

Success in any pursuit depends upon system, and this is essentially true of the study of any branch of natural history. As we gaze around us upon the material world, we behold a conglomerate mass of life that may astonish, or even oppress, us with its multitudinous forms, but until we can take each individual object and trace it down to its proper place in the order of nature, it has no meaning for us. To accomplish this, the natural sciences,—geology, botany, biology,—have been established, and these again have been subdivided, until every object can be assigned to its proper place and its life and peculiarities known and described. There is no field in which subdivision has been called out so fully as in the natural sciences; as a result, we have a perfect system of classification, which enables us to recognize and study with the greatest ease any natural object which comes under our observation.

The earth naturally is divided into three great kingdoms—the mineral, the vegetable, and the animal. The mineral is the first and the oldest. Without it, neither of the others could exist. In fact, the vegetable and animal kingdoms may be considered as subordinate to the mineral and springing from it, for the material part of all vegetable and animal is mineral, and so soon as the vital element has departed, they restore to the mineral what they have borrowed from it. The vegetable kingdom comes next in order, for there could be no animal life until there was abundant vegetable life to support it.

Our business now is only with the animal kingdom, and with only one branch, though a very important branch, of that. This kingdom has been divided into two subkingdoms, known as the Vertebrata and the Invertebrata. The Vertebrata include all animals having a backbone, as mammals, birds, fishes, and reptiles. The Invertebrata cover all that class of animals which have no backbone, or vertebra, and this is by far the larger and more important branch of the animal kingdom, as it includes a vastly greater number of forms and is more numerous in its individuals than is the other.

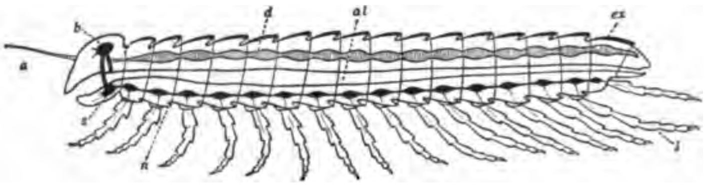


FIG. 1. Diagram to express the fundamental structure of an Arthropod. *a*, **antenna;** *al*, **alimentary canal;** *b*, **brain;** *d*, **dorsal vessel;** *ex*, **exoskeleton;** *l*, **limb;** *n*, **nerve chain;** *s*, **subesophageal ganglion. (After Schmeil.)**

The Invertebrata have been divided into eight branches, as follows:

Protozoa, which includes the lowest forms of animal life. These are single-celled animals, many or most of them exceedingly minute, or even microscopic in size, and without definite shape. In most cases reproduction is effected by subdivision.

Poriferata, which are animals a stage higher in their development, and including sponges and kindred forms.

Cœlenterata, in which we find the jelly-fishes and corals.

Echinodermata, which includes the sea-eggs or sea-urchins and the star-fishes.

Vermes, which covers the various forms of worms, leeches, and their kindred.

Molluscoidea. This is confined to two groups of aquatic animals, the Brachipoda and Polyzoa. The first of these was formerly placed in the

Mollusca, and the latter in the Zoöphytes, but they were found to be more nearly related to each other than to the branches in which they had been included and the Molluscoidea was erected for them.

Mollusca embraces what is commonly known as shell-fish, while the land forms are represented by snails and slugs.

Arthropoda. This is the branch in which we are especially interested. It is separated into two divisions: the Tracheata and Branchiata. The Tracheata are aërial animals, which derive their oxygen from the air by tracheæ or tubes. This division includes insects, myriapods, centipedes, thousand-legged worms, etc., and the Arachnida (spiders, scorpions, etc.). The Branchiata are aquatic animals, which breathe through branchiæ, or gills, or sometimes through the whole surface of the body. There is but one class under this division, the Crustacea, including crabs, lobsters, shrimps, etc. The common sow-bug is a land form of this branch.

Having now reached our subject, and traced the insect group down to its proper place, we will proceed to deal with this class by itself. The following diagram will present to the reader the position of the class *Insecta* in its relation with creation:

- NATURAL KINGDOM.
  - Mineral.
  - Vegetable.
  - Animal.
    - Vertebrata.
    - Invertebrata.
      - Protozoa.
      - Poriferata.
      - Cœlenterata.
      - Echinodermata.
      - Vermes.
      - *Arthropoda.*
      - Molluscoidea.
      - Mollusca.

The branch Arthropoda may be presented in tabular form, as follows:

- ARTHROPODA
  - Tracheata (Breathing by tracheæ)
    - Class 1. Insecta.
    - Class 2. Myriapoda.
    - Class 3. Arachnida.
  - Branchiata (Breathing by branchiæ)
    - Class 4. Crustacea.

Conspicuous examples of the Crustacea are lobsters, crawfish, crabs, shrimps, etc., while the terrestrial forms are represented by the sow-bugs, which are so common in damp locations, and which are frequently mistaken by young entomologists for members of the Myriapoda.

Class 1, *Insecta*, is the only one with which we have any immediate concern, although it is necessary to understand something of the other air-breathing classes, which are so nearly related to the insects, and among which we find forms beneficial or injurious to our fields and orchards.

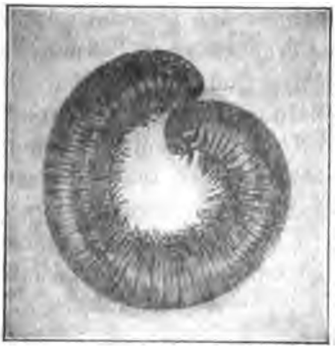


FIG. 2. A diplopod (*Spirobolus marginatus*). Natural size.

The *Crustacea* are of little interest to us, except as members of the Arthropoda. The members of this class are chiefly aquatic, and are grouped with the insects because the general structure is the same.

The distinguishing feature of the Arthropoda is that the bodies are segmented; that is, they are composed of a series of rings fitted into each other or articulated. In some classifications this class is designated as the Articulata, and is made to include the Vermes, or worms, which are also segmented. The latter, however, properly belong in a class by themselves, and the Arthropoda may be stated to include all segmented or ringed animals with legs. It is by far the most important of all the subkingdoms, and includes a larger number of species than all the others combined. The Crustacea fit the description above and are naturally included in the same subkingdom with the insects.

The *Myriapoda* come more directly under our view. They are land animals and, in some cases, are very injurious to crops. The centipedes and millipedes are included in this class. Some of these are very minute and others attain great size. One of the smaller of the centipedes sometimes appears in vast numbers in damp locations and does great damage to young plants.

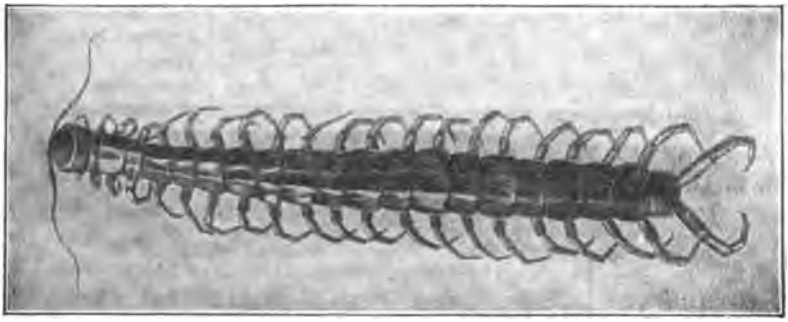


FIG. 3. A centipede (*Scolopendra heros*). About two thirds the maximum length.

The *Arachnida* include the whole of the spider family. They are distinguished from insects by the fact that their members generally have eight legs, while insects have but six. They pass through no metamorphosis, the young resembling the matured members in everything except size, and they have no antennæ. Some of our greatest orchard pests are found in this group, among them being the red spider and various mites; the ticks, which so trouble our poultry and live stock, also belong to this class, as do the phytopti, which infest our pear trees and grapevines. The disease known as the "itch" among men is also caused by a member of this family, called the itch mite. Some of the mites, during the larval or undeveloped stage, have six legs, acquiring their entire complement of eight only when fully developed, and the phytopti have but four legs at any period of their existence. These, however, are exceptions to the rule—that members of this class have eight legs. It will be observed from the above that some of our most troublesome pests are found in this class, but there are also some that are beneficial. In fact, very many of the spiders, which are generally predaceous, perform a beneficial work in keeping down injurious species.

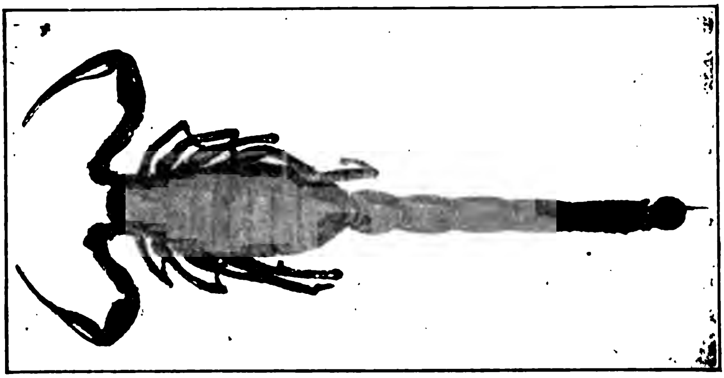


FIG. 4. A scorpion (*Buthus*). Natural size.

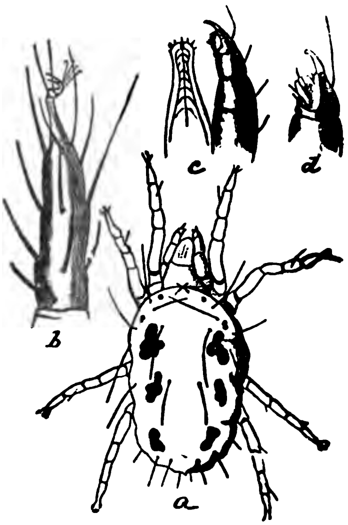


FIG. 5. Six-spotted mite (*Tetranychus maculata*). *a*, insect, much enlarged; *b*, tarsus; *c*, rostrum and palpus, still more enlarged; *d*, tip of palpus, still more enlarged.

CLASSIFICATION.

In order to place properly an insect or other natural object, a system of classification is necessary. As stated before, we have three great kingdoms. All objects have distinguishing characteristics which place them naturally in one or the other of these, and we know at a glance to which they belong. Everything that lives, breathes, walks, flies, or swims, everything with fur, feathers, or scales, we know belongs to the animal kingdom. But among animals there are great dissimilarities. As stated, one great portion has an articulated backbone or vertebra, and another, and more important class, has none; so our great animal kingdom branches off into two forks, and these are known as subkingdoms. It is still easy to tell to which of these an animal belongs, for every child can tell at a glance whether it has a backbone or not. So far our task is easy, but there are great points of difference, even among backbone and non-backbone animals. The snake, the bird, and the horse all have backbones and, therefore, all belong to the subkingdom Vertebrata, but they have little else in common, so the Vertebrata are again divided into four classes—mammalia, birds, reptiles, and fishes. Each of these again is divided and subdivided according to well-marked peculiarities common to the whole group, until we get down to the species and the individual. This has been explained in the preceding pages, where we have followed the insect down to its place in the animal kingdom, through the Invertebrata, Arthropoda, and Tracheata. So by means of the following stages we can trace an insect down to its natural place:

Kingdom,
Subkingdom,
Branch,
Class,
Order,
Family,
Genus,
Species,
Individual.

To illustrate, we will take our common swallow-tailed butterfly, and work it down to its final place:

Kingdom = Animal.
Subkingdom = Invertebrata.
Branch = Arthropoda.
Class = Hexapoda.
Order = Lepidoptera.
Genus = Papilio.
Species = Rutulus.

All of the species Rutulus are alike. Where there are slight variations, these are not fixed, but found only in the individuals. With different members of the genus Papilio, however, there are very distinct differences, yet all have a general similarity, enough to group them in one genus, so all the members of the genus Papilio have characters in common with all other butterflies and are grouped with them in the order Lepidoptera.

Really, the first four of these stages concern us but little. We all know to what kingdom an animal belongs, equally to what subkingdom. Neither the branch nor the class will bother us much, although the knowledge of very many people stops at this and they confound many of the other members of the Arthropoda with the class Hexapoda, and regard spiders, centipedes, scorpions, and, in fact, all things that creep or crawl, and are not beasts, birds, reptiles, or fishes, with insects. It is after we have decided that the object of our interest is an insect that the trouble begins. It is sometimes very difficult to decide to what order it belongs. It is much to know this, and much more to know the family. Beyond this point it is unnecessary for the average entomologist to go. In the case of our more common insects, however, it is well to be able to recognize them by their generic and specific names, and with an acquaintance with the family to which they belong, they can readily be traced to their species.

It is sometimes necessary to enter into closer subdivisions, and, to this end, a higher and a lower section is provided, designated by the prefix *super* or *sub*, as *super*-family and *sub*-family, classing them above or below the regular family as their characteristics seem to indicate.

Dismissing the greater and more general divisions, we now come to the orders, and here we are met with confusion. It would seem as though science, or at least scientists, instead of making matters clear, as they should, take a delight in confusing. A student no sooner gets the system of nomenclature of a science firmly fixed in his memory, or the classification properly versed in his mind, than some new authority steps forward, and, in order to keep up with the times, the student has to unlearn all and learn over again.

There are several groups or orders of insects, ranging from seven to thirty-four, according to the authority. The commonly accepted number of orders has been seven. Westwood gives us thirteen, Comstock makes it nineteen, and Kellogg, the latest authority, gives us nineteen, but makes changes in Comstock's names and arrangement. The differences are in the minor groups or species.

There are six well-defined orders: Orthoptera, Hemiptera, Coleoptera, Diptera, Hymenoptera, and Lepidoptera. Then there is the seventh, the Neuroptera. Now it is an easy matter to assign an insect to any one of the six when it belongs there, but there are numbers of insects which do not clearly belong to any one of these, and the order Neuroptera has furnished a dumping-ground for most of them. When the entomologist found an insect which he could not clearly locate, he called it a Neuropterôn, and let it go at that. This will answer as well, for the purpose of our readers, probably, as any, as the more minute divisions, while undoubtedly correct, are more confusing and less suitable for the non-professional. So we will take the seven orders, as follows:

Orthoptera: The straight-winged; as grasshoppers, crickets, cockroaches, etc.
Hemiptera: The half-winged; as plant bugs, aphids, scale bugs, etc.
Coleoptera: The sheath-winged; as beetles of all kinds.
Diptera: The two-winged; as two-winged flies of all kinds.
Hymenoptera: The membrane-winged; as bees, wasps, ants, etc.
Lepidoptera: The scale-winged; as butterflies and moths.
Neuroptera: The nerve-winged. This order includes all the rest; as dragon-flies, lace-winged flies, etc.

The more minute division, according to Comstock, includes the following, which have principally been removed from the last-named order and erected into separate orders:

Thysanura: The bristle-tails, spring-tails, fish-moths, etc.
Ephemerida: Mayflies.
Odonata: Dragon-flies.
Plecoptera: Stone-flies.
Isopoda: Termites or white ants.
Corrodentia: Book lice.
Malophaga: Bird lice.
Dermaptera: Earwigs.
Physopoda: Thrips.
Mecaptera: Scorpion-flies.
Trichoptera: Caddice-flies.
Syphonaptera: Fleas.

These minor orders are not of much interest to the average man, so it will not be out of place to consider them in their connection with the other orders which contain the great bulk of insects important to us, from either their beneficial or their destructive standpoint.

We have now some idea of the manner in which insects are divided into various classes, and it is necessary that we should learn the distinguishing features of them, in order that we may know to which of the various orders and families they belong. This we shall endeavor to make plain; but first it is necessary to know what an insect is, and something of the peculiarities which separate it from the other branches of the animal world. After considering this, we shall take up the principal orders and point out wherein they differ one from the other.

THE STRUCTURE OF INSECTS.

The external structure of insects is termed the exo-skeleton. In the Vertebrata, the bony framework of the body is internal and supports the muscular and nervous systems, which are attached to the outside of the osseous or bony system. With the insects, the reverse is the case. Here the skeleton is a hard, horny crust, composed largely of a substance called *chitine*, and it is situated on the outer surface, all the muscles and other organs of the body being attached to the inside, instead of the outside, of the skeleton. It is really a many-jointed tube, varying in size in different species, and composed of thirteen rings, most of them so articulated as to be movable at the will of the insect. Of these, the first composes the head, and is the most distinct. Three are fused together in the thorax, and, in most species, appear as one, there being no well-defined mark between the segments, which are immovably joined to each other. In the last section of the body the rings are loosely articulated and freely movable, being joined together with a yielding membrane, allowing the insect the widest freedom of movement. It must not be supposed, however, that these rings, or segments, are composed of one solid, unyielding piece, and that their only motion is at the joints. Each ring is composed of many plates, more or less movable, to accommodate the needs of the insect and to allow the movement of its various organs of locomotion, flight, etc. This outer integument, or case, varies very greatly in density in different insects; in some it is very thin, and easily crushed, while in others it is excessively hard. In some of the beetles, for instance, the wing covers are so hard that it is difficult to force a pin through them.

An insect is divided into three sections: the head, the thorax, and the abdomen. The upper portion, or back, is known as the dorsal surface, or dorsum; the under side is the ventral surface, or venter; while the sides are designated as the lateral surface, or pleurites. The upper and under surfaces of the thorax are sometimes designated respectively as the notum and sternum.

There are very many minor subdivisions into which the different sections of the body are separated, but it is not necessary in this treatise to name or enumerate them, nor for the young entomologist to learn them. If our readers desire to go deeper into the subject, the scientific text-books will give them an account of the more minute subdivisions and their various uses. It is enough for us to get a general idea of our subject, and we shall therefore have to proceed at once to investigate the three principal divisions, their attachments and various organs.

THE HEAD.

In insects, as in the higher animals, the head includes most of the sensory organs—the eyes, the antennæ, and the mouth parts, containing the organs of taste, and, in some species at least, the organs of smell also. The different portions of the head are: The epicranium, which is the upper or dorsal portion of the skull; the face, or front or frons, above which is the vertex or forehead. The clypeus is in the lower portion of the face, and is the part to which the upper lip or labrum is attached. The cheeks are known as genæ, and in some species these are double, and we have post-genæ. On the under side of the head is the gula, to which the lower lip or labium is attached. The external top of the head, in contact with the prothorax, is the occiput. The principal organs of the head are the eyes, the mouth, and the antennæ.

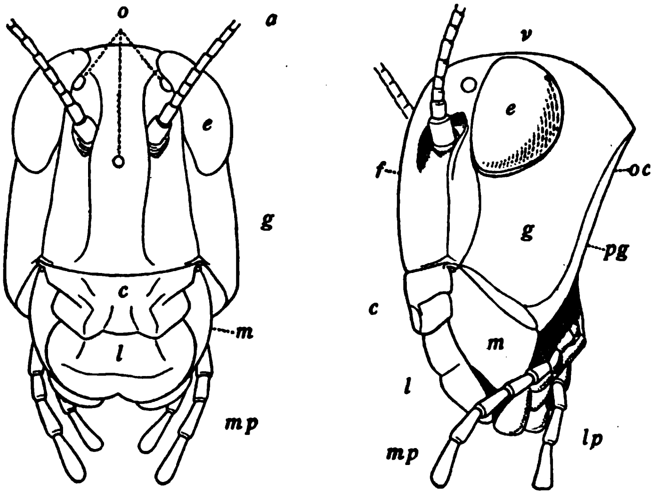


FIG. 6. Skull of a grasshopper (*Melanoplus differentialis*). *a*, antenna; *c*, clypeus; *e*, compound eye; *f*, front; *g*, gena; *l*, labrum; *lp*, labial palpus; *mp*, maxillary palpus; *o*, ocelli; *oc*, occiput; *pg*, post-gena; *v*, vertex.

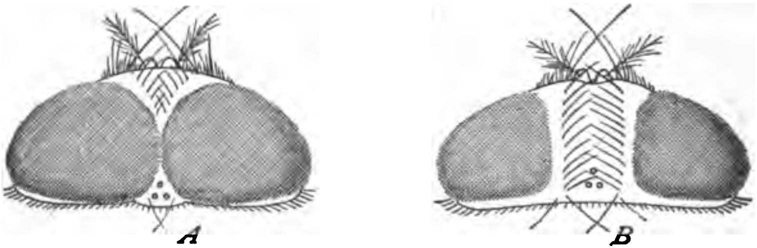


FIG. 7. Ocelli and compound eyes of a fly (*Phormia regina*). A, male; B, female.

Eyes.—In the perfect insect there is a pair of compound eyes. These are usually very prominent and highly faceted. In some insects, as the dragon-fly, the house-fly, and others, they form the greater part of the head. The eye of an insect is immovable, fast in its socket. It is hemispherical or curvilinear in form, and covered with facets or flat surfaces. They are called compound eyes, and are of many colors—blue, black, emerald green, or deep golden, as in the lace-winged fly. Really, each facet is a separate eye, hexagonal in shape, with a cornea, lens, pigment-coating, and nervous filament. The facets face in every direction and enable the insect to see on all sides with greater ease than if they were single lensed and movable. In some cases these facets are very numerous, the eye of a small beetle, the *Mordella*, having over 25,000, the common swallow-tailed butterfly, the *Papilio*, having 17,000, the dragon-fly 12,000, the house-fly 4,000, while the eyes of some ants are limited to 50. Besides these compound eyes, most insects have two or three simple eyes, known as ocelli or stemmata. These are usually arranged in triangular form (thus .·.), and are round and convex in shape. These extra eyes are not present in all insects, nor are their exact functions known. They are possessed of great refractive power and are supposed to be of use in the examination of near-by objects.

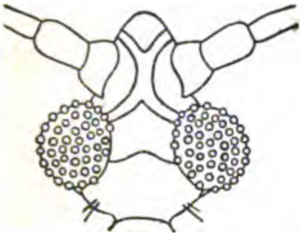


FIG. 8. Agglomerate eyes of a male coccid, *Leachia fuscipennis* (After Signoret.)

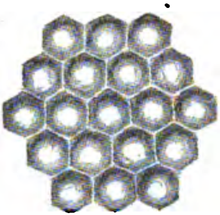


FIG. 9. Facets of a compound eye of *Melanoplus*. Highly magnified.

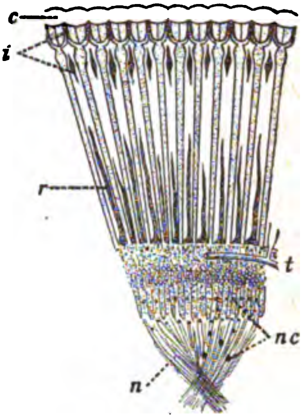


FIG. 10. Portion of compound eye of fly (*Calliphora vomitoria*), radial section. *c*, cornea; *i*, iris pigment; *n*, nerve fibers; *nc*, nerve cells; *r*, retinal pigment; *t*, trachea. (After Hickson.)

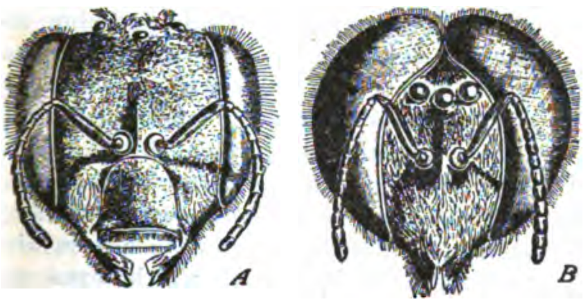


FIG. 11. Ocelli and compound eyes of the honey-bee (*Apis mellifera*). A, queen; B, drone. (After Cheshire.)

Mouth.—The mouth is a very complicated piece of mechanism, and is furnished with various organs, enabling the insect to take its nourishment as its habits require. There are two general classes of

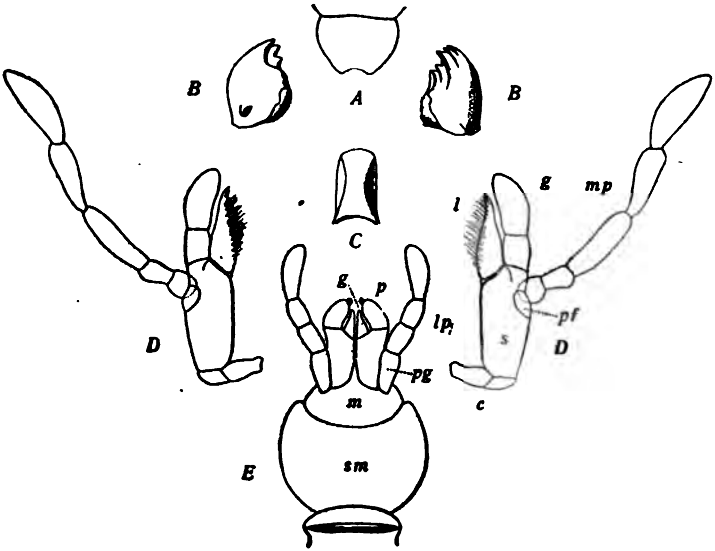


FIG. 12. Mouth parts of a cockroach (*Ischnoptera pennsylvanica*). A, labrum; B, mandible; C, hypopharynx; D, maxilla; E, labium; *c*, cardo; *g* (of maxilla), galea; *g* (of labium), glossa; *l*, lacinia; *lp*, labial palpus; *m*, mentum; *mp*, maxillary palpus; *p*, paraglossa; *pf*, palpifer; *pg*, palpiger; *s*, stipes; *sm*, submentum. B, D, and E are in ventral aspect.

insects, distinguished from each other by their mouth parts, the one having biting or gnawing organs, and known as mandibulate insects. Beetles, grasshoppers, locusts, etc., belong to this class. In the other, the mouth parts are fitted for sucking only, and the insects acquire their nourishment by inserting their beaks into plants or animals and absorbing the juices by suction. These are known as haustellate insects, and in this class we find many of the greatest pests of the farmer and fruit-grower, among them the plant lice, or aphids, scale bugs, etc. In their perfect state, moths and butterflies derive their nourishment by suction, sipping the nectar from flowers with the long, thread-like tube which forms the mouth. Really, the haustellate mouth is a form of the mandibulate, modified to suit the habits of its possessor.

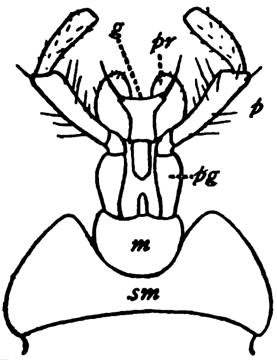


FIG. 13. Labium of *Harpalus caliginosus*, ventral aspect. *g*, united glossæ, termed *the glossa*; *m*, mentum; *p*, palpus; *pg*, palpiger; *pr*, paraglossa; *sm*, submentum. The median portion of the labium beyond the mentum is termed the *ligula*.

In the biting insects (Mandibulates) the mouth is composed of six different parts. First, the mandibles, a pair of horny curved jaws, often serrated, or supplied with sharp, saw-like teeth. Secondly, a second pair of jaws located beneath the mandibles, and generally of four parts and arranged for masticating the food torn off by the mandibles. These organs are known as the maxillæ. To these are usually attached one or two pairs of jointed organs, called palpi, or feelers. One pair of these is attached to the lower jaw or maxilla, and are termed the maxillary palpi, and the others are attached to the lower lip, and are designated the labial palpi. Their office seems to be somewhat like that of the tongue in the higher animals. Third, an upper lip, or labrum, attached to the lower portion of the head; and, fourth, the lower lip, or labium, with its attached palpi. The labium is usually composed of two or more parts, the mentum or chin, which is a broad, horny plate, varying in size in different species, and the ligula, or tongue, which lies on its inner surface. This is usually a membranous or fleshy organ, sometimes supported by a horny plate when it projects beyond the mentum.

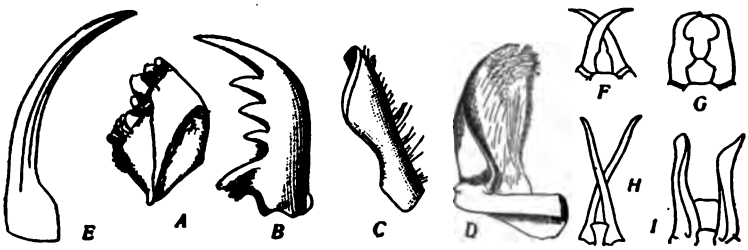


FIG. 14. Various forms of mandibles. A, *Melanoplus;* B, *Cicindela;* C, *Apis;* D, *Onthophagus;* E, *Chrysopa;* F-I, soldier termites. (After Hagen.)

Antennæ.—The antennæ are organs found in all insects, and are situated near the compound eyes and usually between them. These organs vary greatly in different insects and frequently even in the two sexes of one species. In some cases they are mere knobs, as in the ladybirds; in others they are much longer than the entire insect. They are sometimes feathered; sometimes branched, knobbed, or composed of a series of spherical joints joined together like a string of beads. In some cases they connect by a number of plates, and, throughout the whole class, they vary in structure almost as much as the species themselves differ one from the other. What the object of these organs is, has not been definitely determined. They are commonly called feelers, and certainly appear to possess a tactile sense. They may, in some cases, be organs of hearing, and sometimes seem to have auditory qualities. Experiments

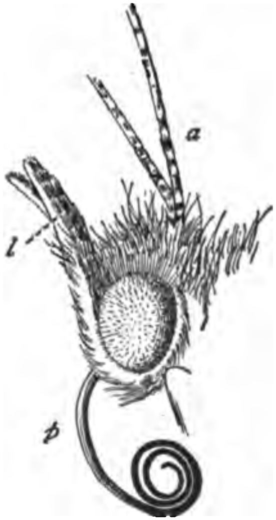


FIG. 15. Head of butterfly (*Vanessa*). *p*, labial palpus; *a*, antennæ; *l*, proboscis.

have shown that in some cases they are organs of smell. In fact, they may be any or all of these, or, as has been suggested, they may be the organs of a sense in insects of which we have no knowledge. Practically, there is but one sense, that of feeling. What we know as sight, hearing, taste, and smell are but different forms of feeling, and are caused by vibrations which convey to our special organs certain sensations, which we designate by different names, but which depend for their reception upon the sensory nerves, and we therefore feel sound, color, flavor, and odors. The antennæ of insects are especially adapted to receive and convey the various forms of vibration, and it is not improbable that they may serve the purposes for which several organs are required in the higher forms of life. Let this be as it may, it is certain that the antennæ of insects are among the most important of their organs. They may be used also for the conveyance of information, as we know that ants and other insects on meeting will communicate to each other by means of their antennæ, and we know also that many insects, especially social insects, have the means of conveying information to each other.

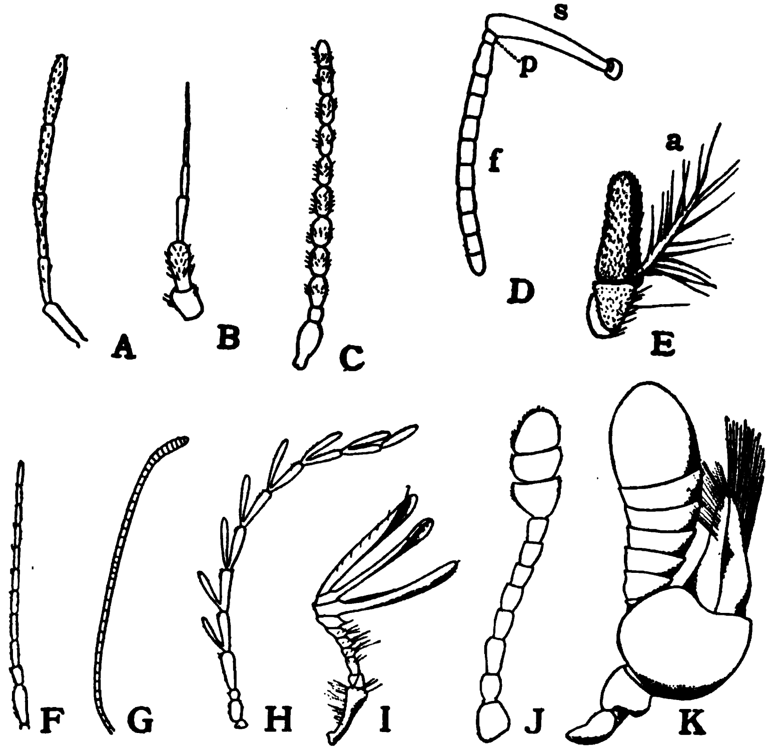


FIG. 16. Various orms of antennæ. A, filiform, *Euschistus;* B, setaceous, *Platemis;* C, moniliform, *Catogenus;* D, geniculate, *Bombus;* *f*, flagellum; *p*, pedicel; *s*, scape; E, irregular, *Phormia;* *a*, arista; F, setaceous, *Galerita;* G, clavate, *Anosia;* H, pectinate, male, *Ptilodactyla;* I, lamellate, *Lachnosterna;* J, capitate, *Megalodacne;* K, irregular, *Dineutus*.

It is necessary that some knowledge should be had of the different forms of antennæ, as these are all classified, and are sometimes used in the description of families. In the beetles, for instance, we have the Clavicornia, club horns; Serricornia, saw horns; Lamellicornia, thin plate horns, etc. So in order to describe the different forms of antennæ, they have been classified as follows (see Fig. 16):

Setaceous: Bristle-like.
Filiform: Thread-like.
Moniliform: Necklace-like.
Serrate: Saw-like.
Pectinate: Comb-like.
Clavate: Club-shaped.
Capitate: Ending in a head or knob.
Lamellate: Plates.
Geniculate: Jointed or kneed.

Besides these general terms others are used in describing the antennæ; as, plumose, or feathered; and "irregular," which includes many forms not included in the above list.

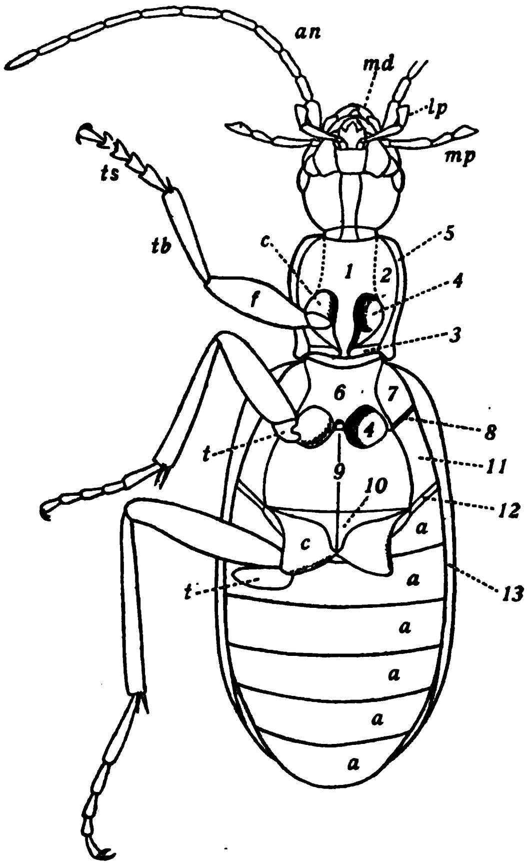


FIG. 17. Ventral aspect of a carabid beetle (*Galerita janus*). 1, prosternum; 2, proepisternum; 3, proepimeron; 4, coxal cavity; 5, inflexed side of pronotum; 6, mesosternum; 7, mesoepisternum; 8, mesoepimeron; 9, mesasternum; 10, antecoxal piece; 11, metaepisternum; 12, metaepimeron; 13, inflexed side of elytron; *a*, sternum of an abdominal segment; *an*, antenna; *c*, coxa; *f*, femur; *lp*, labial palpus; *md*, mandible; *mp*, maxillary palpus; *t*, trochanter; *tb*, tibia; *ts*, tarsus.

THE THORAX AND ITS APPENDAGES.

The foregoing will give the student a general idea of the head and its various organs, the eyes, the mouth, and the antennæ, and we will now proceed to consider the next important division of the body, the thorax. This is composed of three segments immediately back of the head. These segments are named pro-, meso- and metathorax. The first, or the one connecting with the head, being the prothorax, the middle section the mesothorax, and the last, the one connecting with the abdomen, being the metathorax. These segments appear to be solid rings, but really they are composed of several hexagonal plates, capable of motion and to which the various appendages are articulated. Each of these segments bears one pair of legs, but only the meso- and metathorax bear wings, and either or both pairs of wings may be wanting; as in the flies there is but one pair, and in many insects none.

Legs.—In most adult insects and many larvæ, each of the three thoracic segments bears one pair of legs, composed of several parts. That joint immediately attached to the body is known as the coxa, the next as the trochanter, femur, tibia, and tarsus, the latter corresponding to the foot in the higher animals. The legs are modified in many ways to meet the requirements of the insect, and are adapted to running, leaping, swimming, burrowing, or grasping their prey, according to the habits of the species. The tarsus is composed of several parts or segments, usually five, the last one generally being provided with one or two claws.

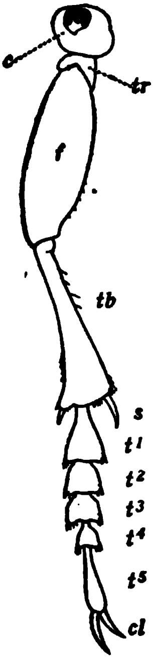


FIG. 18. Leg of a beetle (*Calosoma calidum*). *c*, coxa; *cl*, claws; *f*, femur; *s*, spur; t^1-t^5, tarsal segments; *tb*, tibia; *tr*, trochanter.

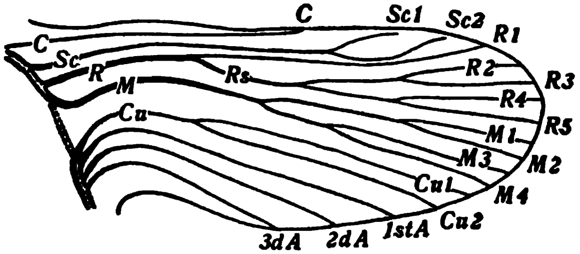


FIG. 19. Hypothetical type of venation. A, anal vein; C, costa; Cu, cubitus; M, media; R, radius; Sc, subcosta. (After Comstock and Needham.)

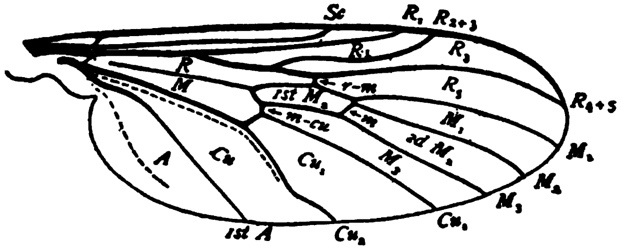


FIG. 20. Wing of a fly (*Rhyphus*). A, anal vein; C, costa; Cu, cubitus; M, media; R, radius; Sc, subcosta. (After Comstock and Needham.)

Wings.—There are usually two pairs of wings, and these are borne on the last two segments of the thorax—the mesothorax and the metathorax. As above stated, either one or both pairs may be absent, but when so they are usually represented by rudimentary pads or other organs. In the order Diptera, or two-winged flies, a pair of small hooked or knobbed organs, known as halteres, or poisers, represent them. In earwigs and beetles the first pair of wings are represented by a hard, horny wing covering, known as the elytra. The upper wings are designated as superiors, anteriors or primaries, and the hinder wings as posteriors or secondaries. Commonly they are known as fore and hind wings, which is good enough for practical use.

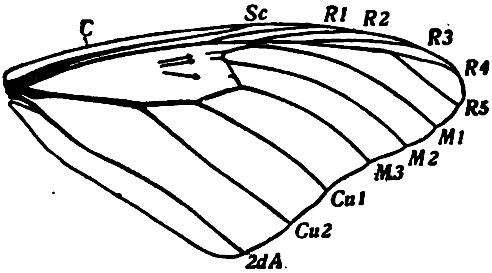


FIG. 21. Wings of a butterfly (*Anosia*). A, anal vein; C, costa; Cu, cubitus; M, media; R, radius. Sc, subcosta. (After Comstock and Needham.)

The wings of an insect may be compared to a boy's kite, in which a light membrane is tightly stretched over a tough framework. In the insect we find a strong framework of horny tubes, termed veins or nerves, with a tough, membranous film on either side. The arrangement of these veins is called the venation or neuration, and is exceedingly variable, so much so that expert entomologists can tell to what order or family, and often to what species, an insect belongs by the arrangement of its wing veins. The spaces between the veins are termed cells. With all this variation, however, in all wings there are certain well-marked veins, common to all, and these have all been named and numbered. The principal veins are known as the costa, subcosta, radius, cubitus, media, and anal. These are found in some form in all wings.

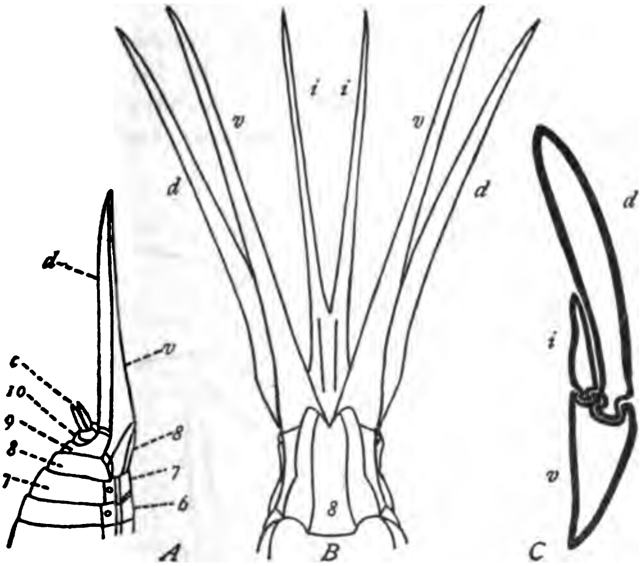


FIG. 22. Ovipositor of *Locusta*. A, lateral aspect; B, ventral aspect; C, transverse section; *c*, cerci; *d*, dorsal valve; *i*, inner valve; *v*, ventral valve. The numbers refer to abdominal segments. (After Kolbe and Dewitz.)

Insect wings vary not only in form, but also greatly in color and texture, and among them, especially in the butterflies, moths, and beetles, we find the most exquisite expression of color, form, and arrangement in nature.

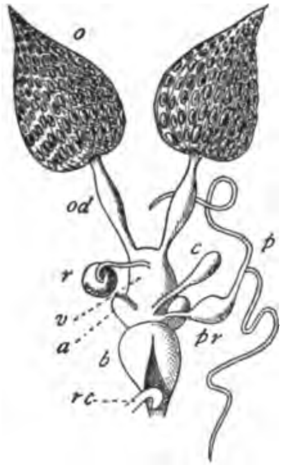


FIG. 23. Reproductive system of queen honey-bee. *a*, accessory sac of vagina; *b*, bulb of stinging apparatus; *c*, colleterial, or cement, gland; *o*, ovary; *od*, oviduct; *p*, poison glands; *pr*, poison reservoir; *r*, receptaculum seminis; *rc*, rectum; *v*, vagina. (After Leuckart.)

THE ABDOMEN.

This is the third and last portion of the body, and is generally composed of nine segments. The number, however, varies greatly, and in the cuckoo-flies there are but three or four to be seen. The principal organs of the abdomen are those of respiration, digestion, and reproduction. The latter varies greatly in different species, especially in the female, in some cases being elongated into a long tube, the ovipositor; in some being supplemented with a sting; in others being supplied with sawing or piercing organs; all of which serve for the proper deposition of the egg in its future food supply, which instinct forces the mother insect to select.

As stated above, the abdomen is composed of nine segments, but these are not always distinct. It is usually considered as composed of two parts, the abdomen and post-abdomen, the latter being composed of the three terminal segments. In the abdomen proper, we never find articulated appendages, with perhaps the single exception of a small beetle, the *Spiractha eurymedusa*. On the post-abdominal segments, such appendages are frequently found; as the honey tubes of the aphids, the forceps of the earwigs, and the thick bristles of the cockroaches.

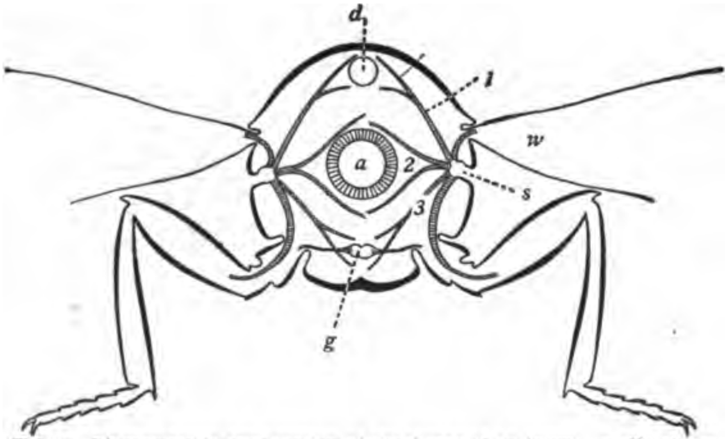


FIG. 24. Diagrammatic cross-section of the thorax of an insect. *a*, alimentary canal; *d*, dorsal vessel; *g*, ganglion; *s*, spiracle; *w*, wing; 1, dorsal tracheal branch; 2, visceral branch; 3, ventral branch.

THE INTERNAL ORGANS.

Having now given a short account of the external organs of insects, we will glance at their internal organs, which comprise a digestive, circulatory, respiratory, and nervous system.

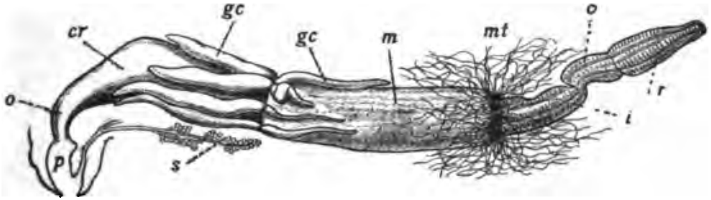


FIG. 25. Alimentary tract of a grasshopper (*Melanoplus differentialis*). *c*, colon; *cr*, crop; *gc*, *gc*, gastric cæca; *i*, ileum; *m*, mid intestine, or stomach; *mt*, Malpighian, or kidney, tubes; *o*, esophagus; *p*, pharynx; *r*, rectum; *s*, salivary gland of left side.

The digestive organs consist, as in the higher animals, of a continuous tube, somewhat longer than the body, varying in form with different insects, from a simple tube in the Thysanura, to a complicated system in the higher orders. It is usually supplied with a crop, gizzard, stomach, and necessary assimilative organs. The digestive tube is divided into three parts: the large intestine, the small intestine, and the rectum.

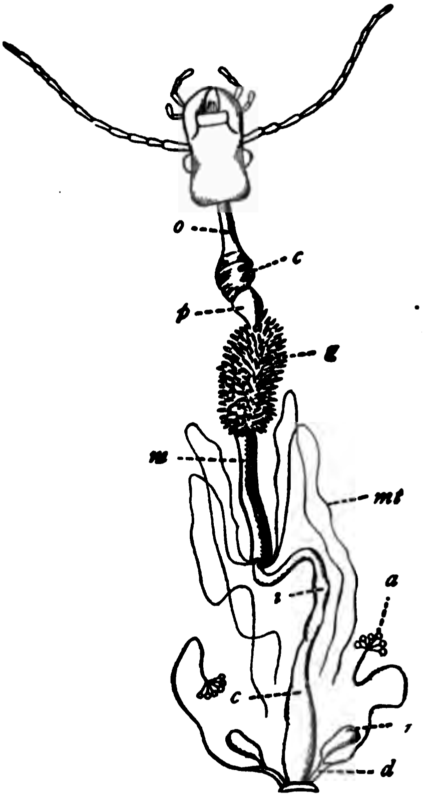


FIG. 26. Digestive system of a beetle (*Carabus*). *a*, anal gland; *c* (of fore gut), crop; *c* (of hind gut), colon, merging into rectum; *d*, evacuating duct of anal gland; *g*, gastric cæca; *i*, ileum; *m*, mid intestine; *mt*, Malpighian tubes; *o*, esophagus; *p*, proventriculus; *r*, reservoir. (After Kolbe.)

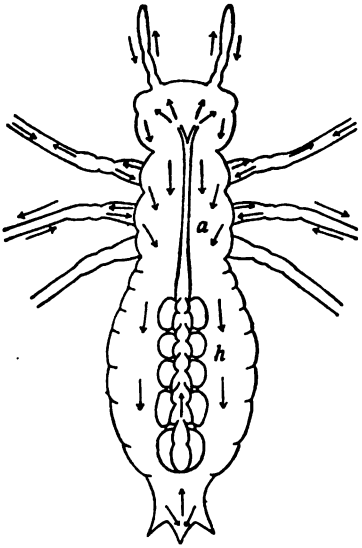


FIG. 27. Diagram to indicate the course of blood in the nymph of a dragon-fly (*Epitheca*). *a*, aorta; *h*, heart; the arrows show direction taken by currents of blood. (After Kolbe.)

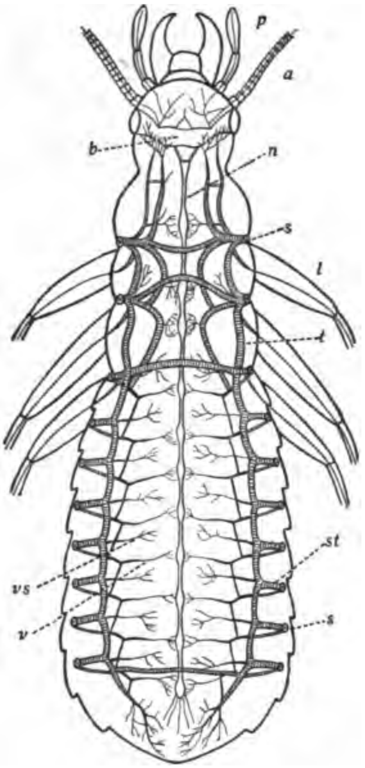
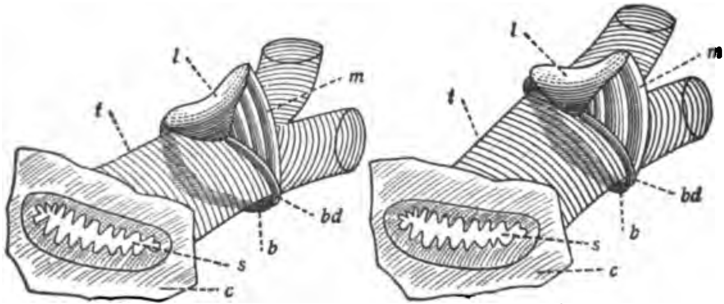


FIG. 28. Tracheal system of an insect. *a*, antenna; *b*, brain; *l*, leg; *n*, nerve cord; *p*, palpus; *s*, spiracle; *st*, spiracular, or stigmatal, branch; *t*, main tracheal trunk; *v*, ventral branch; *vs*, visceral branch. (After Kolbe.)

The circulation of insects is as yet imperfectly understood. The blood is cold, and, except for a slight yellowish tint, is colorless. There is no system of closed blood vessels, as in the higher animals, but the blood is forced through the body cavities by an organ which represents the heart. This organ is a delicate tube, located in the upper surface of the body, and is usually called the dorsal vessel. This represents the heart, and ordinarily consists of eight sections, or sacs, which open into each other and which, by contracting, drive the blood forward to the region of the head, where it escapes into the body cavity. No system of arteries or veins has been traced. In its course through the body, the blood becomes oxygenated by contact with the respiratory organs, which penetrate into all parts of the body. (See Fig. 27.)

The respiratory system consists of a vast number of tubes or tracheæ, which have their openings to the outer air along the sides of the insect. These air tubes are known as spiracles or stigmata. They are usually placed on each side of every segment, excepting the head, and communicate with a main tracheal trunk which extends along the sides of the body. One of these trunks is situated on each side and from these the tracheæ branch off in all directions until the whole body is permeated with these delicate air tubes and thoroughly aërated.



Trachea opened. Trachea closed.

FIG. 29. Apparatus for closing the spiracular trachea in a beetle (*Lucanus*). *b*, bow; *bd*, band; *c*, external cuticula; *l*, lever; *m*, muscle; *s*, spiracle; *t*, trachea. (After Judeich and Nitsche).

The nervous system of insects consists of two thread-like cords running the length of the body, connecting which are nerve centers, or ganglia. From these centers, or ganglia, nerve threads branch and reach all parts of the body, governing the sense and motion of the insect. In the lower forms of life the brain is a mere nerve thread running through the body. As we advance from the lower to the higher, we discover small swellings or lumps along this thread. These are the ganglia, and each one forms a separate little brain, all connected with the main thread. Still further, we find, branching off from these ganglia, other threads, and we have a nervous system. In the higher animals, the bulb in the head is much the larger and dominates all the rest, and we know it as the brain, and the rest as the nervous system. In the higher animals there are two sets of nerves, one known as the

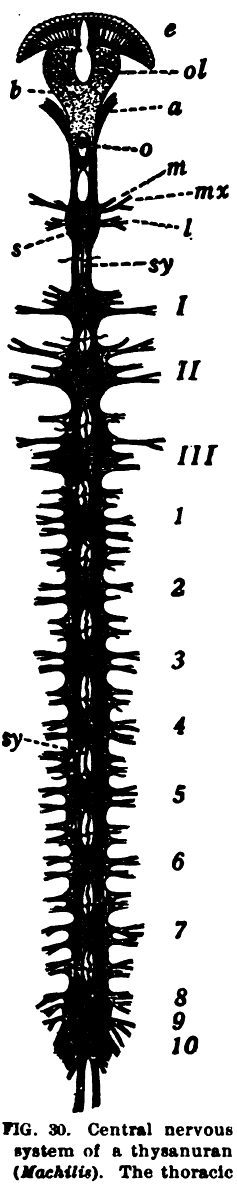


FIG. 30. Central nervous system of a thysanuran (*Machilis*). The thoracic and abdominal ganglia are numbered in succession. *a*, antennal nerve; *b*, brain; *e*, compound eye; *l*, labial nerve; *m*, mandibular nerve; *mx*, maxillary nerve; *o*, esophagus; *ol*, optic lobe; *s*, subesophageal ganglion; *sy*, sympathetic nerve. (After Oudemans.)

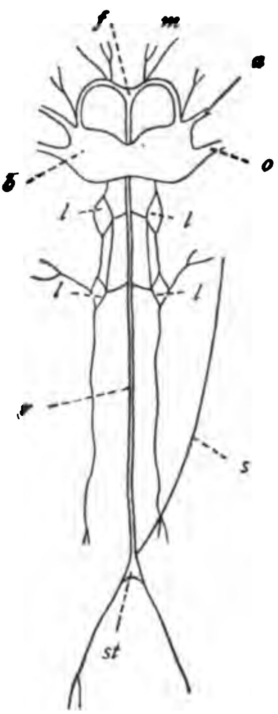


FIG. 31. Sympathetic nervous system of an insect, diagrammatically represented. *a*, antennal nerve; *b*, brain, *f*, frontal ganglion; *l*, *l*, paired lateral ganglia; *m*, nerves to upper mouth parts; *o*, optic nerve; *r*, recurrent nerve; *s*, nerve to salivary glands; *st*, stomachic ganglion. (After Kolbe.)

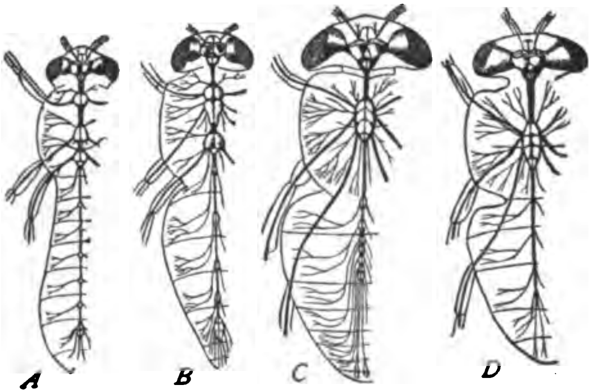


FIG. 32. Successive stages in the concentration of the central nervous system of Diptera. A, Chironomus; B, Empis; C, Tabanus; D, Sarcophaga. (After Brandt.)

sensory nerves, or those with which we feel and which convey impressions to the brain, and the motor nerves, or those which receive impressions from the brain. The one set enables us to feel, the other to act. With the lower insects the brain and nervous system are very simple, but in the higher orders it becomes more complicated, and is evidence of the possession of much intelligent force.

THE TRANSFORMATION OF INSECTS.

One of the most peculiar and wonderful of natural phenomena is the transformation or metamorphosis of insects—a process which, were it not so common and going on under our observation every day, would be unbelievable. If we did not know of it, and some traveler should tell us that in a distant country he had seen animals that in one stage of their existence were repulsive worms, and then became mummified, losing all semblance to themselves, being practically dead for some time, and then broke forth from their mummy cases into the most beautiful and brilliant creatures imaginable, far exceeding any other animal in their beauty, we should regard him as drawing upon a very vivid imagination and relating things that were utterly impossible. Yet it is all true, and it is so common that it all passes under our eyes without a thought on our part of the wonder of it.

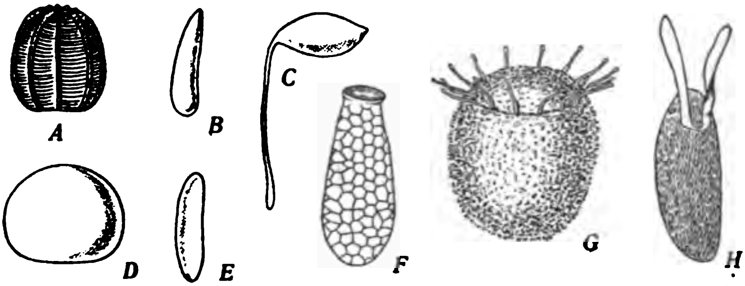


FIG. 33. Eggs of various insects. A, butterfly, *Polygonia interrogationis;* B, house-fly, *Musca domestica;* C, chalcid, *Bruchophagus funebris;* D, butterfly, *Papilio troilus;* E, midge, *Cecidomyia trifolii;* F, hemipteron, *Triphleps insidiosus;* G, hemipteron, *Podisus spinosus;* H, fly, *Drosophila ampelophila.* Greatly magnified.

The insect passes through four stages: the egg, the larva, the pupa, and the imago. The egg is the germ, the beginning, the contained potentiality, which, under proper conditions, brings forth the new being. The second stage, the larva, is the growing period. In this the insect eats, increases in size, sheds its skin, or molts, several times, until it has stored up sufficient tissue for the final stage. But there is an intermediate stage, one of remarkable change, in which the insect ceases to be a mere eating, growing thing, and is transformed into its perfect shape. This is the pupal form. At last the final change takes place, and we have the new being in all its perfection.

It may be set down as an axiom that all the beauties of the animal and vegetable kingdoms are for the purpose of sexual attraction, the whole object of them being the continuation of the species. Plants are plain and uninteresting until they attain their growth and put forth their blossoms, and these blossoms, with their gorgeous hues and beautiful forms, are for the sole purpose of attracting the insects, the little go-betweens in the love-making of the plants, which carry the fructifying pollen from one to the other and make possible a future crop of plants, flowers, and seeds, and so it goes on forever.

It is so in the metamorphoses of insects. At the last it has ceased to be a gourmand. In many cases, its voracious appetite ceased with its larval life and it lives by sipping the nectar of the plants. It has now acquired its full sexual strength, its full sexual beauty, and its great object in life now is to be attractive to the other sex. For this purpose the bright colors are developed in some, peculiar markings in others—strange shapes, rapid flight, strength, or other characteristics, having for their one object the continuance of the species. This accomplished, their life cycle has closed and they pass, like the rest of us, from this stage forever.

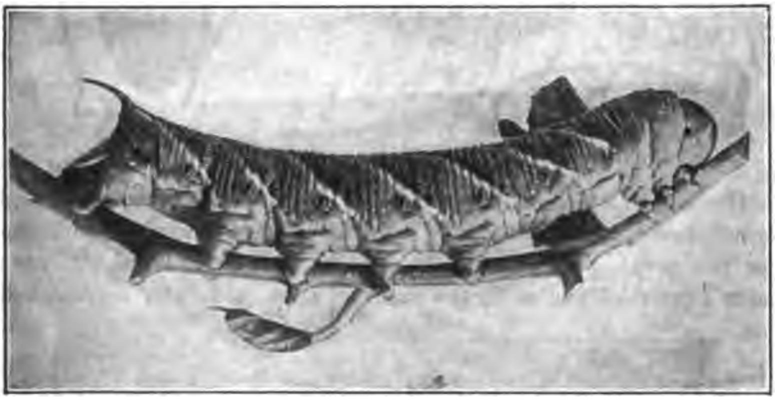


FIG. 34. Caterpillar of *Phlegethontius sexta*. Natural size.

Metamorphoses are not similar in all the orders. In some of the orders we have what is known as "direct," or incomplete, metamorphosis; in this case there is no passive stage, and in many cases the change from the larval to the perfect form is hardly noticeable. In others, the larvæ, or nymphs, as they are called, molt several times, and, at the last, where they are winged at all, the wings develop and the insect becomes perfect, or enters upon the imago stage. Among insects of this class we have the bugs, or Hemiptera, the grasshoppers, crickets, cockroaches, and other members of the order Orthoptera. These insects passing through the direct metamorphosis are classed together under the name of Holometabola.

The other group, which have an "indirect" or complete metamorphosis, are grouped together as Heterametabola. In these, the insects pass through the regular stages: the egg, the growing larva, the pupa, and the perfect insect or imago.

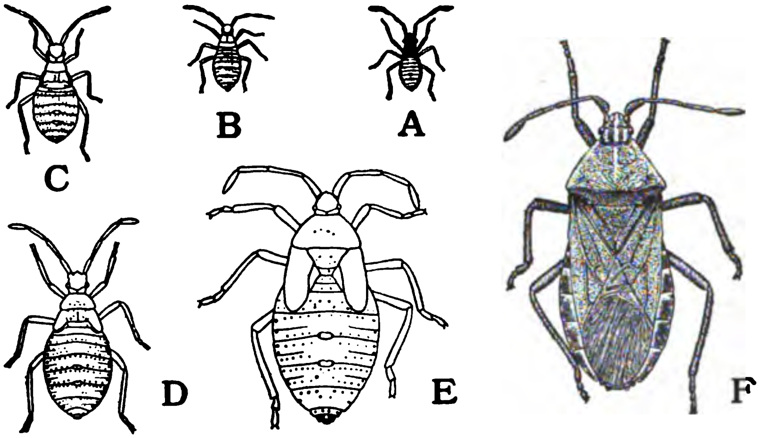


FIG. 35. Six successive instars of the squash-bug (*Anasa tristis*).

In the pupal stage of most insects having an indirect or complete metamorphosis, there is a strong approach to suspended animation, for while the pupa will sometimes squirm, when touched, it usually remains in perfect rest until the great change has been accomplished.

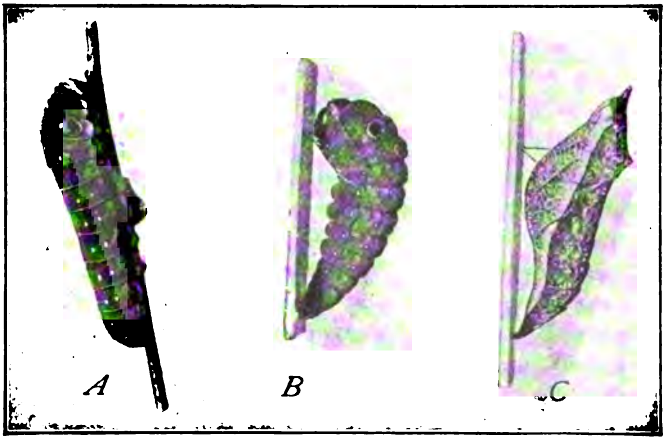
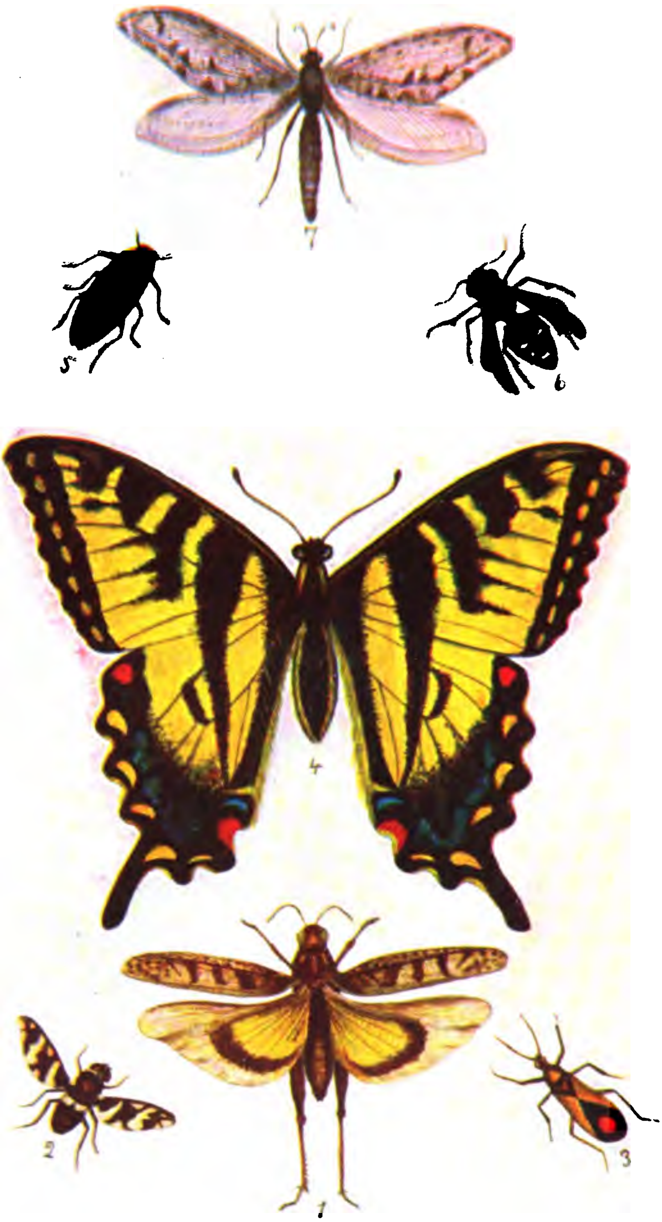


FIG. 36. *Papilio troilus*. A, larva; B, larva suspended for pupation; C, chrysalis. Natural size.

In those insects which have a direct metamorphosis, the insect in its transition stage is spoken of as a nymph.

The changing insect in other cases is known as a pupa, although in the case of butterflies it is often referred to as a chrysalis.

PLATE I



Representatives of the Seven Principal Orders of Insects

PLATE I.

Representatives of the Seven Principal Orders of Insects.

1. Orthoptera—*Hippiscus rugosus.*
2. Diptera—*Exoprosopa caliptera.*
3. Hemiptera—*Rasahus biguttatus.*
4. Lepidoptera—*Papilio turnus.*
5. Coleoptera—*Buprestis.*
6. Hymenoptera—*Vespa germanica.*
7. Neuroptera—*Polystœchotes punctatus.*

All natural size.

The change is one of the most wonderful operations in nature. It is as if the original larva had been entirely destroyed and an animal of an entirely new species had appeared. With its pupa integument, it has lost all the organs characteristic of the larval stage, and an entire new set have been provided. It now possesses six true legs, wings suited for rapid flight, compound eyes, antennæ, a more perfect nervous system, while, in the case of many insects, the sharp, gnawing jaws of the larva, which were adapted to cutting leaves or boring into wood, have been replaced with long, delicate tubes suited to absorbing the nectar of flowers. The very instincts of the insect are changed, and the life habits of the larva and the imago are as different as their outward appearance.

THE ORDERS OF INSECTS.

We have now given an outline of the structure and peculiarities of insects as a whole, and have reached a point where we can segregate them into groups or orders, which is necessary for closer study. As stated before, there are seven principal orders of insects—Orthoptera, Hemiptera, Neuroptera, Coleoptera, Diptera, Hymenoptera, and Lepidoptera. There are, as we said, several minor orders, but the above classification will answer our purpose and we will consider them in the order named.

Order **ORTHOPTERA.**

Orthoptera means straight-winged, and alludes to the fact that the hinder wings, when folded, lie perfectly straight down the back of the insect without any folds. The anterior wings are of little, if any, service in flight, serving principally as a covering for the large posterior wings, which, when spread, are semicircular in shape, and open and close like a fan. They are of large size, and the principal veins radiate, like the sticks of a fan, from the center. Not all members of this order are winged, however, many of them being apterous, or wingless.

The head is usually large and very prominent, and the antennæ either short, stout, and few-pointed, as in the locust, or very long and slender, as in the katydid. The head bears one pair of large compound eyes and usually two or three ocelli or simple eyes, and the mouth parts are suited for gnawing or biting.

The Orthoptera have a direct or incomplete metamorphosis. The young, when hatched, very much resemble the mature insect, and in the first or larval stage are wingless. They pass through several molts when the wingpads appear, and they are now known as nymphs. At the last molt the wings are fully developed, and the insect is perfect.

They are voracious in all their stages, and while we find a beneficial member of the order in the mantis, we also find in it many of our most destructive insects, the grasshoppers, locusts, crickets, cockroaches, etc. Our readers are fully alive to the devastation wrought by one of the families of this order—the locusts—as California, and the whole Pacific Coast, frequently suffer severely from their depredations. With, perhaps, the exception of the *Cicada*, or seventeen-year locust, which, by the way, is not a locust, but a "bug," as explained elsewhere, we find in this order the only "singing" insects, and the song of the cricket on the hearth and the katydid in the trees has given most people a kindly feeling for these destructive insects, not felt toward others.

The Orthoptera are classed in six families, which Comstock describes as follows:

- *The Running Orthoptera.*—The body is oval when seen from above and is very flat; the three pairs of legs are similar in form; the insects run rapidly........ *Blattidæ*
- *The Grasping Orthoptera.*—The prothorax is very long and slender; the first pair of legs are very different from the others, and are fitted for grasping........ *Mantidæ*
- *The Walking Orthoptera.*—The body is very long and slender; the three pairs of legs are similar in form, and are also very long and slender; the insects walk slowly........ *Phasmidæ*
- *The Jumping Orthoptera.*—The hind legs are very much stouter or very much longer, or both stouter and longer, than the middle pair, being fitted for jumping. This group includes three families:
  - *The Short-Horned Grasshoppers, or Locusts.*—The antennæ are shorter than the body. The ovipositor of the female is short and composed of four separate plates. The tarsi are three-jointed........ *Acrididæ*
  - *The Long-Horned Grasshoppers.*—The antennæ are very slender and longer than the body. (This is also true of the crickets.) The ovipositor is sword-shaped. The tarsi are four-jointed........ *Locustidæ*
  - *The Crickets.*—The antennæ, like those of the long-horned grasshoppers, are very slender and longer than the body, except in the mole-crickets. The ovipositor is spear-shaped when exerted. The tarsi are three-jointed........ *Gryllidæ*

These families are sometimes grouped in two large sections: the Saltatoria, or the leapers, in which the hind legs are much lengthened and formed for jumping, as the crickets, grasshoppers, and locusts, and the Cursoria, in which the legs are formed for running, as the cockroaches, etc. The latter group includes the first mentioned three families, and the first group the others.

Section **CURSORIA.**

Family **Blattidæ.** At the head of the section Cursoria is placed the Blattidæ, or roaches. While few of them are known to California, there are a thousand or more species in the world. Many of these live in the fields and find shelter under sticks and stones. Some are wingless, and all are nocturnal and very fond of heat and moisture. It is on this account that they swarm in kitchens, around sinks, in pantries, the holds of ships and steamers, and similar locations.

The female lays her eggs in a purse-like pouch, in a double row, which she carries with her for some time before she deposits it. This mass resembles a small, brown bean in shape. In some cases it is asserted that the female remains with and cares for her young. They breed in enormous quantities, and once introduced into a house will soon overrun it, but on account of their nocturnal habits and timorous disposition, they may be present in quantities, yet remain unsuspected. Going suddenly into the kitchen with a light will sometimes show them by hundreds scampering off in all directions for a place of retreat.

Like most of our pests, the worst of the cockroaches is an introduced species. They are omnivorous in diet and do much damage to books and clothing, besides overrunning and devouring food in the pantry and cupboards.

Insect powder freely dusted over books and similar articles will drive them away, while powdered borax mixed with sugar, of which they are very fond, will kill them in large numbers.

Family **Mantidæ** (The Mantis). This family includes about twenty species in our country, and is the one beneficial family of the order. From its peculiar habit of holding its head erect, its fore legs raised, and remaining motionless in this position for some time, the most conspicuous member of the family has been named "The Praying Mantis." If a pun were permissible, it might be called "The Preying Mantis," for its patience, devout attitude, and generally saintly appearance are designed to throw other insects off their guard, which, when they come within reach of the waiting, watchful mantis, are quickly grasped between the fore legs, their juices sucked from their bodies, which are then thrown aside, while the mantis again assumes its devotional attitude and awaits a fresh victim.

All the species of Mantidæ are carnivorous, but in securing their prey they depend altogether upon their resemblance to twigs, leaves, etc., and wait for their victims to come within their reach, when they are quickly seized and devoured. The eggs are laid in masses, inclosed in a soft silk-like substance, through which the young gnaw their way as soon as hatched. These insects are cannibals, for if there is no other food within easy reach the young will devour each other.

Family **Phasmidæ** (Walking-sticks). This is a peculiar family, and comprises within it some of the largest and most monstrous appearing creatures of the insect world. They are strangely formed and depend for their protection and their food upon their mimicry. Some of them strongly resemble green twigs, others dry twigs, some the leaves of trees, and so strong is the likeness that it is almost impossible to detect them upon the tree where they are at rest. These insects are most numerous in the tropics, where they sometimes attain a length of eight or ten inches. All are vegetable feeders, and would become injurious were they introduced and acclimated, but, being tropical, there is little danger from this source.

Some members of the family are found in the Eastern states, through the Mississippi Valley and in the South, but none have ever been reported from California.

Section SALTATORIA.

Family **Acrididæ** (The Locusts). This is a family in which we are especially interested, as it includes the most destructive foes of the farmers of the West. The members of this family are distinguished from others of the order in having the antennæ—composed of from six to twenty-four joints—shorter than the body. It is from this fact that they are sometimes called the short-horned grasshoppers.

The females lay their eggs, usually underground, but sometimes in other locations, in an oval, bean-like mass. The number of eggs in each mass varies from twenty or thirty to double that number. The holes for the reception of the eggs are made by means of two pairs of horny valves at the tip of the abdomen of the female. These open and shut rapidly and are well adapted to execute this function. The female, by pressing the tip of her abdomen forcibly against the soil, rapidly opens and shuts these hard-pointed valves and soon pushes them into the ground, thus drilling a hole. In a short time the entire and greatly extended abdomen is inserted in the little curved and more or less oblique cavity. The legs are hoisted above the back during the operation of drilling the hole, which requires more or less time, depending entirely upon the character of the soil. As soon as the hole is finished, it is filled with frothy and mucous material.

Professor Riley describes the method of egg-laying as follows: "By repeatedly extracting and studying specimens in every stage of oviposition, we have been able to ascertain the exact method by which the egg mass is formed. If we could manage to watch a female from the time the bottom of her hole is moistened by the sebific fluid, we should see the valves all brought together, when an egg would pass down the oviduct along the ventral side, and, guided by a little finger-like style, pass in between the horny valves, and issue at their tips amid the mucous fluid already spoken of. Then follows a period of convulsions, during which more mucous material is elaborated, until the whole end of the body is bathed in it, when another egg passes down and is placed in position. These alternate processes continue until the full complement of eggs are in place, the number ranging from twenty to thirty-five, but averaging about twenty-eight. The mucous matter binds all the eggs in a mass, and when the last is laid, the mother devotes some time to filling up the somewhat narrower neck of the burrow with a compact and cellular mass of the same material, which, although light and easily penetrated, is more or less impervious to water, and forms a very excellent protection. When fresh, the mass is soft and moist, but it soon acquires a firm consistency."

The Rocky Mountain locust (*Melanoplus spretus*) is the most dreaded of any of our American species. This species finds an ideal breeding place in the high plateaus of the Rocky Mountains, where tens of thousands of square miles have been untouched by the plow for all the ages. Here they breed undisturbed, and by countless millions, and those who have never seen a flight of these insects can form no idea of their numbers—or perhaps, of their quantity, for numbers is an inadequate term. In their flight, they will sometimes swoop down upon a fertile section and in a short time devastate hundreds of square miles. Kansas has suffered severely from their depredations, until Kansas and locusts have become connected in the mind. Yet these insects are not indigenous to Kansas, nor can they thrive there. Their natural habitat is the high plateaus of the Rocky Mountains at an elevation of from 2,000 to 10,000 feet. Here, when their food supply becomes short, a swarm will sometimes rise in the air, and on their expanded wings may be carried hundreds of miles on an air current until they alight in a place far distant from their breeding grounds. Thus they reached Kansas and did damage for several years. Each year their numbers became fewer until they disappeared, Kansas and its climate not being suited to them.

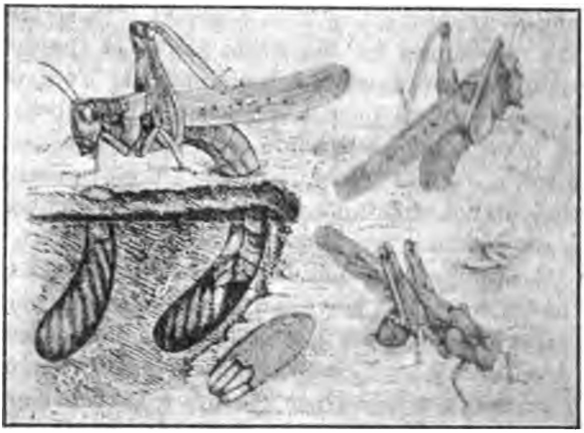


FIG. 37. Rocky Mountain locust (*Melanoplus spretus*) ovipositing. Females with abdomen inserted in the soil; egg-pod broken open and lying on the surface; a few scattered eggs; section of soil removed to show eggs being put in place, and egg-pod sealed over.

Swarms of Rocky Mountain locusts reach Utah, Idaho, Nevada, and frequently eastern California; occasional small swarms pass over the Sierra Nevada range, but on this side of the range they have never been very numerous or in sufficient quantities to be serious.

There is, however, a close relation to this pest—*Melanoplus devastator*—with which California is too well acquainted. This is the locust which appears in swarms each season in some parts of the State, the foothill regions of the Sacramento and the San Joaquin valleys being especially afflicted with their visitations. Fortunately their breeding grounds are not so extensive, their swarms much smaller, and their destructive powers vastly less than *M. spretus*. But they are bad enough. From historic records, it is evident that this pest was much worse in California in early days than at the present time, swarms of them having been recorded even near San Francisco. This is natural, as the insects breed in the wild, uncultivated land, and, as the country becomes more densely settled and more intensely cultivated, their breeding area is more and more circumscribed, their swarms reduced, and their destructive area lessened. Their favorite breeding grounds are now found on the warm slopes of the foothills, those having a southwestern exposure being preferred. Here, where the soil is too thin for agricultural purposes, and is left undisturbed, large swarms of *M. devastator* breed and do great damage on the cultivated lands in the vicinity. Fortunately, there are efficient parasites for these pests, and they do not often appear in destructive numbers for two years in succession in the same place.

Grasshoppers in such localities usually make their appearance during the latter part of May, and in the following months of June and July cause their greatest destruction. After that, effects of disease, attacks of natural enemies, and their extension over a wider area so reduce their numbers in a given locality that their depredations are comparatively so small as to pass unnoticed.

Grasshoppers generally first appear in greatest numbers along the edges of the foothills, which are their breeding ground, in isolated swarms, often many miles apart. When first hatched, their powers of destruction are not great; but with each molt their voraciousness increases, and unless steps are promptly taken to combat them, or unless attacked by their natural enemies in numbers, cultivated crops in their path may be seriously injured or destroyed by them.

The grasshopper has many enemies. A tachina fly, about the size of the common house-fly, and which it much resembles, is one of the most abundant and most destructive to the hoppers. Birds also aid greatly in their destruction. The common meadowlark is among the most active destroyers of this insect. When grasshoppers are plentiful the meadowlark does not eat the entire insect, but only the abdomen or a portion of one, and this habit enables it to destroy a great number every day. Blackbirds of all varieties are also great aids in destroying them, but, unfortunately, the birds are breeding and taking care of their young when the grasshoppers first appear, and as their nestingplaces are close to water in the tules and the breeding grounds of the grasshoppers are near the foothills, perhaps miles away, their services are not so valuable in proportion to their numbers as those of the meadowlark, whose home may be in the midst of the young grasshoppers or adjacent thereto. Later in the season, the blackbirds become fearfully destructive of grasshoppers. Woodpeckers also for a time cease their arboreal habits to prey upon the grasshoppers on the ground. While the sparrowhawks, owls, sparrows, groundlarks, and, in fact, all kinds of land birds, except the dove, give their welcome aid in destroying the pests. It is said that skunks and gophers eat them, as do also toads, frogs, and snakes.

Grasshoppers, like all insects that gather in large swarms, are subject to contagious diseases, which spread rapidly and carry them off in large numbers, often almost exterminating them. A fungous disease is one of the most fatal to grasshoppers in some countries.

But when grasshoppers become numerous and destructive, it is not wise for farmers or horticulturists to await the action of natural causes, for proximity to cultivated areas does not give the necessary' time for their action before great damage has been done. The farmer must, therefore, be prepared to defend his crop. The best method to combat the pest is to plow the land known to contain eggs, before the grasshoppers are hatched. When the young hoppers have appeared, they may be plowed under and destroyed. Plowing should commence at, the outer boundary of the grasshopper section, and a number of •plows should be used at the same time, the plows following each other as closely as possible. The grasshoppers are in this manner forced to the center, where a black mass of struggling insects are crowded together. But few of them will escape, for as one plow makes a furrow, which is rapidly filled with grasshoppers, the following plow covers them under and they are buried alive, few of them escaping.

The genus *Melanoplus*, to which both of the above described locusts belong, is a very extensive one, including one hundred and twenty species in the United States, and is the largest of all the Acridid genera.

The next most destructive member of the subfamily Acridinæ is the *Œdaleonotus enigma*, which species is sometimes very numerous and destructive.

Family **Locustidæ**. Dismissing the family Acrididæ, which includes the numerous and destructive locust genera, we come to the next family, the Locustidæ, to which, by the way, the locusts do not belong. This includes the katydids, meadow grasshoppers, wingless crickets, etc. Their common and peculiar characteristics are their very long antennæ, which, in many species, greatly exceed the length of the body, and the prominent wings in many of those which have these organs. In those species which have well-developed wings, the males are provided with an elaborate musical apparatus, the use of which is to call the females. The chirping made by these insects is familiar to most people, to all who have spent a summer in the country, and the short rasping sound made by one species (*Cyrtophyllus concavus*) has given it the popular name of katydid, which its song is supposed to resemble. In the different species, each has its own distinct note, and entomologists who have made a special study of them can distinguish each by its peculiar sound.

Comstock arranges the Locustidæ in four general groups for facility in studying, to which he gives the everyday names of:

1. The Meadow Grasshoppers, including the smaller and common members of the family, which abound in meadows and moist places.

2. The Katydids, or tree crickets, generally bright green in color, strongly resembling the foliage among which they live, and which render night musical with their songs. One of the most common of these in California is the angular-winged katydid (*Microcentrum retinervis*). The eggs of the insect are laid in a double row along the edge of a leaf, a twig, or other object, overlapping each other like a row of shingles, and are often mistaken for scale insects.

3. The Cricket-like Grasshoppers, which are found under stones and rubbish, especially in woods, and which are wingless.

4. The Shield-back Grasshopper, also wingless, dull colored, and resembling crickets. This group is represented in California by the *Stenopelmatus irregularis*, a large, clumsy creature, with a big head and long antennæ, which lives under stones and strongly resembles the mole or Indian cricket.

Family **Gryllidæ** (The Crickets). The members of this family of jumping Orthoptera resemble the Locustidæ, in that they have long, slender, tapering antennæ, but differ from them in having the wings laid flat on the back, the forewings bent down on the sides. The ovipositor in the female is long and pointed, while in the Locustidæ it is flat and sword-like. The males of this family are the greatest of all insect musicians, and the sharp chirp, chirp, chirp of the cricket is well known. The commonest and best known of these insects is the field cricket, which appears in such quantities in our country towns on warm summer nights, where they are attracted to the electric light and perish by millions without apparently diminishing the next season's supply. Every warm night in every summer brings them out in countless swarms. It is this insect that we generally understand as being meant when the cricket is alluded to, yet it is but one of a very numerous family, comprising eight subfamilies, each containing several genera and species. These, however, are classed into three distinct groups, a classification ample for any but the most minute, scientific study. These groups are:

1. Mole Crickets, heavy bodied, large-sized burrowing insects, frequently brought to the surface in digging or plowing. This is among the most peculiar of these insects. It is well named the "mole cricket," as in its general form and habits it resembles that animal. The front legs are short, very stout, and furnished with strong tibiæ, well suited for digging and much like the fore paws of the mole. These insects live wholly underground, and feed upon the tender roots of plants, becoming a very serious nuisance where they are numerous.

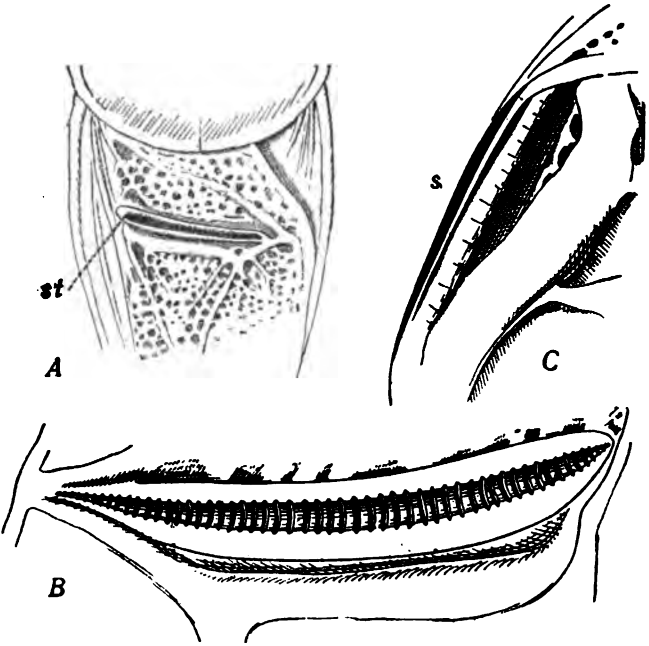


FIG. 38. Stridulating organs of *Microcentrum laurifolium*. A, dorsal aspect of *file* (st) when the tegmina are closed; B, ventral aspect of left tegmen to show *file;* C, dorsal aspect of right tegmen to show *scraper* (s).

2. True Crickets, which include the common house and field crickets, which visit us in such hordes in the summer nights. The eggs of these insects are generally laid in the fall, in light, sandy soil, and remain until spring, when they hatch and the young begin to eat, grow, and molt, until they attain their growth and their wings later in the summer, when they become very much in evidence. They are serious pests, being omnivorous feeders, and will devour anything in their way. If they secure entrance to the house, which they often do, cotton and woolen fabrics alike will be damaged by them. They are in no way choice in the matter of diet and do not turn away from their own kind, but will devour each other with avidity and a keen relish.

3. Tree Crickets, which are found on trees and shrubs, as a rule, although they are sometimes found on grass and herbs. They are delicate and rather small insects, as compared with other members of the family. In laying her eggs the female cuts a groove in the tender canes of raspberry and blackberry vines, or of fruit trees, and in these

her eggs are deposited in a long row. Much damage is often done from this cause, when the insect is numerous, as the twigs are likely to die above the point of damage.

The Earwigs.—Until recently the earwigs were classed with the Orthoptera, but a new order, *Euplexoptera*, has been erected for them. These insects are readily recognized by the forceps-like appendages at the end of the body. These organs are used in folding the wings of the insect, which are snugly tucked away under the wing covers when at rest. They are vegetable-feeders, and where numerous do much damage. They are nocturnal in their habits and are not frequently met with in the daytime. In California the order is represented by *Amsolabis*, a black, wingless species, about three fourths of an inch long, with short, heavy forceps.

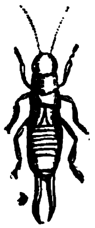


FIG. 39. Full-grown larva of earwig (*Forficula auricularia*). Enlarged.

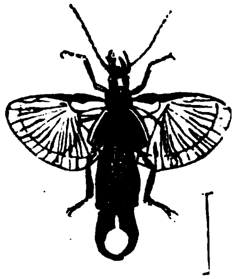


FIG. 40. Adult earwig (*Forficula auricularia*). Enlarged.

Order HEMIPTERA.

We now come to the order of most importance to the fruit-grower and the farmer, for in this we find the greater number of enemies of plant life; in fact, while there are some beneficial species in it, we may say that it is the pest order of the insect world. In this we find the entire group of scale bugs, the aphids or plant-lice, the phylloxera of the grape, and woolly-aphis of the apple; it gives us those most detested of all insects, bedbugs and lice. It is a bad order, but as there is no such thing as unmixed evil or absolute good, so even this order, composed as it is wholly of suckers, supplies us with some members that work for our good. There are those which prey upon their kind; the assassin-bugs as they are called, from the fact that they are predaceous upon other insects and live by sucking the blood of their fellows.

The name *Hemiptera* means half-winged, and these insects are so named from the fact that most of the members of this order have wing covers that are partly thick and leathery, and partly thin and membranous. While this name was given to the order at an early date, and was tolerably applicable to it, still there were found to be a great many insects which properly belonged here to which it was not applicable, as their wings were not half-and-half, so the order has been divided into two suborders, called *Heteroptera*, having diverse wings, and *Homoptera*, having similar wings, so an insect in this order is either *Hemiptera homoptera*, or *Hemiptera heteroptera*. There is still another group belonging to this order, the members of which are wingless, which prey upon other animals, and protect themselves by hiding on the body of their host, or crawling away in cracks and crevices, to issue in the night when all is still and suck the blood of their victims. This group is known as *Parasita*, and will need little further allusion, as it only indirectly affects the orchardist and farmer.

The Hemiptera is one of the most numerous of all the orders. It includes over five thousand known species in North America, and to it belongs the one suborder which the entomologist recognizes as "bugs." To the lay mind all insects are bugs, but to the scientific mind the term brings up a member of the order *Hemiptera heteroptera;* these are the true bugs.

Like the preceding order, the metamorphosis is direct or incomplete. The young insect, as soon as hatched, strongly resembles the adult in shape, and, in many cases, in coloring. It is wingless in its earlier stages, and in some species always so, and passes through several molts in attaining its adult form. The winged species acquire their perfect wings after the last molt.

The members of this order are very diverse in form, size, and markings, and there is no order in which there is such disparity in the appearance of the different families. We have within it the *Cicada* and the mealy-bug, the giant water-bug, which is attracted to the electric light in such great numbers as to have acquired the name of "electric-light bug," and the common scale-bug. In it we find giants of the insect world, and species so minute as to require a strong glass to make them visible. But all through, there is one characteristic which is possessed in common by all, big and little alike—they are all suckers, and live by imbibing the juices or blood of plants and animals. They form the greater part of the Haustellates, or sucking insects, the other half of the insect world being known as the Mandibulates, or biters—a very respectable group compared with the one we are now treating on. The mouth parts are formed for piercing and sucking, and vary in length in different species. The sucking beak can readily be seen by examining the insect, where it will be detected on the under side, folded close to the body. In many species there is a groove into which the beak fits snugly when not in use, and in these it is sometimes difficult to detect it. This beak is really a compound instrument, and is composed of four bristles inclosed in a jointed sheath. Two of these bristles are supposed to represent the mandibles and two the maxillæ of the mandibulate insects, while the sheath takes the place of the labium.

As stated, this order is divided into three suborders: 1. Parasita; 2. Homoptera; 3. Heteroptera.

Of the first of these, little more need be said. Nearly every animal and most birds have a particular species of lice which prey upon them, and people engaged in breeding animals and fowls are sometimes confronted with a serious problem in getting rid of them. This is said to be a degraded family, since they have through their degraded habits lost their wings, and to a great extent powers of locomotion, being wholly dependent upon the bodies of their hosts, to which they are attached all their lives. They have, however, become highly specialized for this style of life, and are well adapted for it.

While on this subject we may state that the bird-lice are not true lice, nor do they belong to the order now under consideration. With the true lice, the mouth parts are made for suction—haustellate—and they properly belong to the Hemiptera, the bird-lice and the book-lice have biting mouth parts, and for these separate orders have been erected, the biting bird-lice being classified as *Mallophaga*, and the book lice as *Corrodentia*.

Suborder **HETEROPTERA**. (The True Bugs.)

The word Heteroptera means having diverse or different wings, and included in this suborder are the true bugs of the entomologist, for while, as before stated, to the average person all insects are bugs, to the entomologist the term means only members of this suborder.

The common squash-bug may be taken as the type of this group. When winged, their wings differ from the suborder Homoptera in the composition and position of the wing covers and in the direction of the head. The insects in this suborder have the head horizontal, on a plane with the body, the beak arising from the front. The wing covers lie flat on the back, and are composed of three separate pieces: corium, clavus, and membrane. These parts are modified in different species in a great variety of ways.

The young of this suborder are known as nymphæ, and after the third molt show the rudiments of wings. The nymphæ are sometimes quite different in coloring to the mature insect. Some difficulty has been experienced in arranging a perfect synopsis of this suborder, which has been arranged in twenty-six families. They have been divided into two groups, the long-horned bugs and the short-horned bugs. About one third of them live in the water, a large section near the water, and the rest on land. They may therefore be classed as Aquatic, Amphibious, and Terrestrial bugs. The following synopsis of families is arranged by Comstock:

THE SHORT-HORNED BUGS. Bugs with short antennæ, which are nearly or quite concealed beneath the head.

- BUGS THAT LIVE WITHIN WATER.
  - The Water-boatmen. Family Corisidæ.
  - The Back-swimmers. Family Notonectidæ.
  - The Water-Scorpions. Family Nepidæ.
  - The Giant Water-bugs. Family Belostomidæ.
  - The Creeping Water-bugs. Family Naucoridæ.
- BUGS THAT LIVE NEAR WATER.
  - The Toad-shaped Bugs. Family Galgulidæ.

THE LONG-HORNED BUGS. Bugs with antennæ at least as long as the head, and prominent except in the Phymatidæ, where they are concealed under the sides of the prothorax.

- THE SEMI-AQUATIC BUGS.
  - The Shore-bugs. Family Salididæ.
  - The Broad-shouldered Water-striders. Family Veliidæ.
  - The Water-striders. Family Hydrobatidæ.
  - The Marsh-treaders. Family Limnobatidæ.
- THE LAND-BUGS.
  - *The Land-bugs with four-jointed antennæ.*
    - The Thread-legged Bugs. Family Emesidæ.
    - The Assassin-bugs. Family Reduviidæ.
    - The Damsel-bugs. Family Nabidæ.
    - The Ambush-bugs. Family Phymatidæ.
    - The Flat-bugs. Family Aradidæ.
    - The Lace-bugs. Family Tingitidæ.
    - The Bedbug and the Flower-bugs. Family Acanthiidæ.
    - The Leaf-bugs. Family Capsidæ.
    - The Red-bug Family. Family Pyrrhocoridæ.
    - The Chinch-bug Family. Family Lygæidæ.
    - The Stilt-bugs. Family Berytidæ.
    - The Squash-bug Family. Family Coreidæ.
  - *The Land-bugs with five-jointed antennæ.*
    - The Stink-bug Family. Family Pentatomidæ.
    - The Burrower-bugs. Family Cydnidæ.
    - The Negro-bugs. Family Corimelænidæ.
    - The Shield-backed bugs. Family Scutelleridæ.

Many of these are of little interest to us and can be dismissed with a mere allusion.

Family **Corisidæ** (Water-boatmen). These are smallish insects, less than half an inch in length, and frequent pools, streams, and ponds. They are surrounded by a film of air and look like a bubble in the water, as they are seen usually on the bottoms. They are generally distributed over the United States, and are predaceous on other water insects. They have no economic importance with us, but in some parts of Mexico they are so numerous in the ponds that aquatic plants upon which they have deposited their eggs are gathered, dried, and beaten in order that the eggs may be secured for food.

Family **Notonectidæ** (Back-swimmers). These are aquatic bugs, their backs shaped like the bottom of a boat. They always swim on their backs, hence the common name. Their hind legs are oar-shaped, and they pass through the water with their aid with great rapidity. They prey upon young fish, and probably are destructive in this respect.

Family **Nepidæ** (Water-Scorpions). This is another of the aquatic bugs, and derives its common name from the possession of a long respiratory tube, at the end of the abdomen, which gives it a strong resemblance to the land-scorpion. There are two distinct types of these insects, one having an oval, flat, thin body, the other a linear and cylindrical body. The latter strongly resembles a stick in the water, where it is usually found in the dirt of the bottom. The family is predaceous, and probably their peculiar form enables them to capture their prey.

Family **Belostomidæ** (Electric-light Bugs). In the hot summer nights, a very large insect will be seen flying around the electric lights in cities near watercourses or lakes. Many of these fall to the ground, where they are crushed under the heel of the pedestrian. These have become so noticeable since the introduction of electric lights that many people believe that they have been produced by the electricity, and their common name of "electric-light bugs" has been given them in recent years. These belong to the family Belostomidæ, which family includes the giants of the bug order. The common electric-light bug in our California towns will reach a length of two inches and is the *Belostoma americanum*, while in the tropics and in Mexico, specimens are common three to four inches in length. In their larval form they are wholly aquatic. Their eggs are attached to the stems of water plants or other convenient objects, and, as soon as hatched, they commence their predatory career. They are exceedingly destructive to young fish, the young of frogs and toads, and other small game within their reach, which they capture by means of their strong fore feet and leisurely suck the blood. This insect is very numerous in Sacramento and in the valley where the great water areas furnish it ideal breeding grounds, and on summer nights they may be seen by thousands under the electric lights.

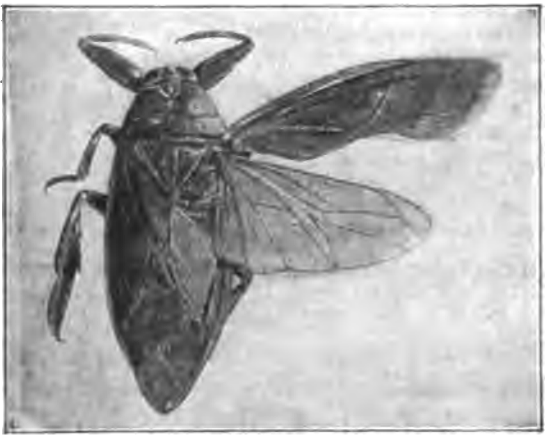


FIG. 41. Electric-light bug (*Belostoma americanum*). Natural size.

A peculiar member of this family is the genus *Zaitha*, in which the female lays her eggs on the back of the male, and he is compelled to carry them about and care for them until he is relieved of the load by their hatching. The male resents this indignity, but the female compels him to submit, and sometimes this is accomplished only after a struggle of several hours. In spite of protests and struggles, however, his better half always gets the best of the argument and he has to take care of the babies. It was at one time thought that the female laid the eggs on her own back, but this belief was corrected by Miss Slater, who made a study of this insect. In speaking of it, this lady says: "That the male chafes under the burden is unmistakable; in fact, my suspicions as to the sex of the egg-carrier were first aroused by watching one in an aquarium which was trying to free itself from its load of eggs, an exhibition of a lack of maternal interest not to be expected in a female carrying her own eggs. Generally the Zaithas are very active, darting about with great rapidity; but an egg-bearer remains quietly clinging to a leaf with the end of the abdomen just out of the water. If attacked, he meekly receives the blows, seemingly preferring death, which, in several cases, was the result, to the indignity of carrying and caring for the eggs."

Family **Naucoridæ** (Creeping Water-bugs). These are rather small, flat-bodied, oval insects, predaceous in their habits, but not common on this coast, and of no economic importance.

Family **Galgulidæ** (Toad-shaped Bugs). These include a family of predaceous bugs only found near the margins of streams, and which are of no importance economically.

Family **Salididæ** (Shore-bugs). These are small, soft, dark-colored insects, with white or yellowish markings. Some are shiny black, but none of any importance to us.

Family **Veliidæ** (Broad-shouldered Water-striders). This is a small family of peculiarly shaped insects. Their legs are formed for running over the surface of water, but they can also travel on land with considerable speed.

Family **Hydrobatidæ** (Water-striders). The members of this family are well known to all who have ever observed insects skimming along over the surface of the water. Often they gather in large numbers, and, when disturbed, dart, with lightning-like rapidity, in all directions. They have no economic value, being neither good nor harmful.

Family **Limnobatidæ** (Marsh-treaders). There is but a single species of this family in the United States, and this is of no economic value.

Family **Emesidæ** (Thread-legged Bugs). This is a small family of very peculiar bugs. The body is long and slender and the middle and hind legs very long and thread-like. The fore legs are constructed for grasping, and resemble those of the praying mantis. It frequents trees, and is predaceous in its habits.

Family **Reduviidæ** (Assassin-bugs). We now come to a family of more interest to us, as in this are many of the most beneficial of the bug family. The members of this family are all predaceous and voracious. They usually attack other insects and suck their juices, but the higher animals are not free from their attacks, and the kissing-bug belongs here. They have a very powerful beak, and can inflict a painful wound, if not carefully handled. One of the members of this family has a local reputation, and in the mountains it is known as the lumberman's bedbug. It is sometimes known as the Big Bedbug, and is the *Conorhinus sanguisugus*.

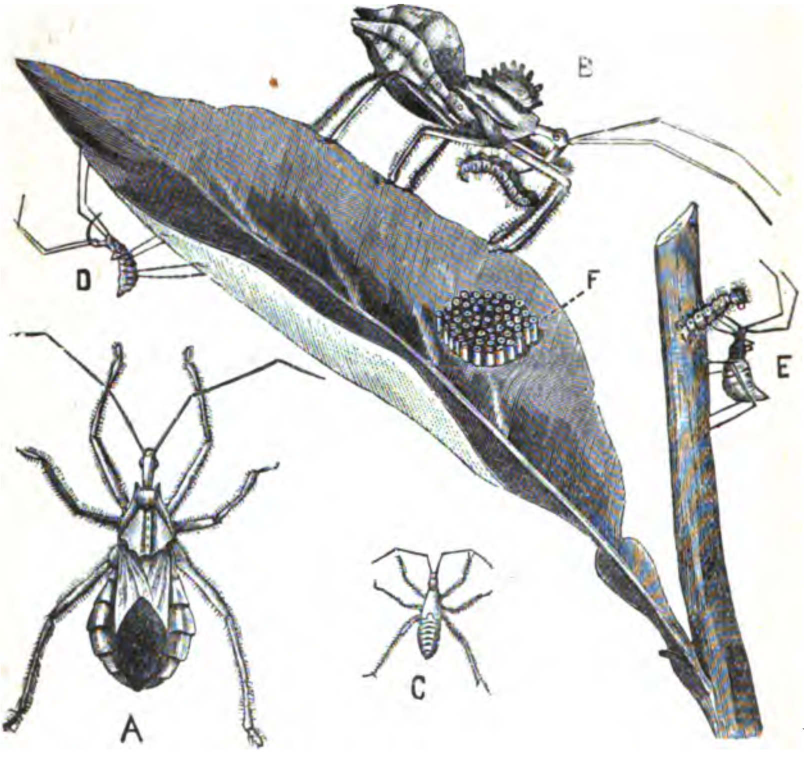


FIG. 42. Wheel-bug (*Prionidus cristatus*). A, adult insect; B, adult insect devouring a caterpillar; C, larva; D, larva; E, larva devouring a caterpillar; F, egg cluster. All enlarged.

A peculiar member of this family is *Opsicœtus personatus*, which, in its younger form, covers itself with particles of dust, and is coated even to the tips of its feet and antennæ. It enters houses and is an inveterate enemy of the bedbug, which it captures and sucks the blood from. From this habit it is known as the "Masked bedbug hunter." This mask is worn only during its immature stage; when fully developed it is about half an inch in length, and is one of about fifty members of this family known as kissing-bugs. It preys also upon flies and other insects. It has a very sharp beak, which it uses in its defense.

Another of the kissing-bugs, which appeared in large numbers in

California some years ago, is *Melanolestes picipes*. This insect is black, and is commonly found hiding beneath stones and boards. It can inflict a very painful wound.

The wheel-bug (*Prionidus cristatus*) is one of the most beneficial of the bug class, as it preys upon leaf-eating caterpillars, and does not hesitate to attack hairy worms, as the tussock-moths, fall web-worm, etc.

This is a large family, representing nine subfamilies and at least fifty genera. They are usually long, rakish-looking insects, with prominent, bulging eyes. The body color is generally dark-brown or black, although some of the members are lighter colored and in some cases beautifully marked. They have a three-jointed beak and are quick in their motions. Altogether the members of this family Reduviidæ or assassin-bugs may be regarded as friends of the fruit-grower, florist, and farmer, and should be protected, even at the expense of an occasional puncture from their beak.

Family **Nabidæ** (Damsel-bugs). This is a small family of predaceous insects. They generally hide among the blossoms and foliage of plants, where they prey upon small insects.

Family **Phymatidæ** (Ambush-bugs). These insects are called ambush bugs from their habit of concealing themselves and seizing their prey unawares. The most striking feature of this insect is in the peculiar form of the front legs, which are especially adapted for seizing and holding their prey. While a small insect, it will seize and hold an insect very much larger than itself, and will catch cabbage-worms, bees, and even wasps, and devour them.

Family **Aradidæ** (Flat-bugs). This family comprises the flattest of all the bugs. Its members live under the bark of decaying trees and in cracks where their flat bodies make it possible for them to creep.

Family **Tingitidæ** (Lace-bugs). This is a family of very small but very beautiful insects. Their common name is given on account of the beautiful lace-like markings of the wing covers, which are reticulated in a manner strongly resembling fine lace work. This insect is very common in California, where it attacks many plants and sometimes becomes so numerous as to seriously interfere with the health of the plant attacked.

Family **Acanthiidæ** (Bedbugs and Flower-bugs). The bedbug needs no description here. It is too well known, and no insect is more thoroughly detested. But there is a very close relation to this pest, which have wing covers fully developed and which are found on flowers and in other locations. They are predaceous, and are known as the flower-bugs.

Family **Capsidæ** (Leaf-bugs). This is the largest of any of the families of true bugs, including more than two hundred species in the United States alone. Most of the members live upon leaves of plants, but some of them are predaceous and prey upon other insects. In this family we find the tarnished plant-bug, the four-lined leaf-bug, and many other of our injurious species.

Family **Pyrrhocoridæ** (Red-bugs). Insects belonging to this family are usually large in size, stoutly built and marked with strongly contrasting colors, in which red and black are conspicuous. The cotton-stainer is a member of this family, and has earned an unenviable notoriety from its habit of puncturing and discoloring the opening bolls of the cotton plant. This bug is a serious pest in Florida, where it pierces the rind of oranges, causing decay to set in.

Family **Lygæidæ** (Chinch-bugs). This is another large family, comprising nine subfamilies and a hundred and fifty species in the United States. The chinch-bug is the representative of the family, and probably the most destructive member of it. This is a rather small bug, but its destruction in the United States each year will run into many millions of dollars. It has two broods a year, and appears in enormous numbers, attacking the stems of grain and grass. While we have this insect in California, it has never been so destructive as in the Mississippi Valley, due probably to the custom which prevails here of burning over the stubble in the grain fields after harvest, by which means these insects are destroyed by millions and their increase prevented. In this family, too, we find the false chinch-bug, a very common insect here, and which somewhat resembles the true chinch-bug, but is never so numerous or destructive.

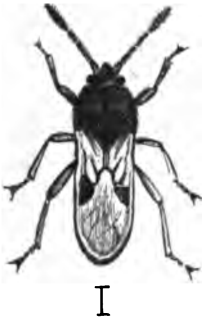


FIG. 43. Chinch-bug (*Blissus leucopterus*). Enlarged.

Family **Berytidæ** (Stilt-bugs). This is a small family of land bugs, in which the legs, body, and antennæ are all very slender. They resemble the crane-fly in general build, and are found in the undergrowth of woods and pastures.

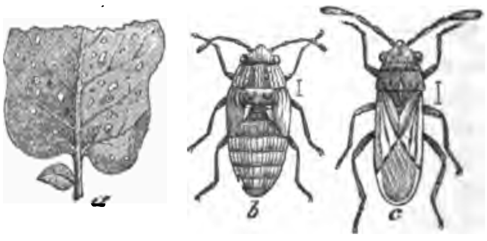


FIG. 44. False chinch-bug (*Nysius angustatus*). Enlarged.

Family **Coreidæ** (Squash-bugs). This is another large family, and is divided into many subfamilies and species. The family comprises both carnivorous and vegetable-feeding forms, and in some cases the same species will attack both animals and plants. A common species in our State is *Leptocoris trivittatus*, the box-elder bug.

Family **Pentatomidæ** (Stink-bugs). Every one who has lived in the country, and especially all our fruit-growers, is well acquainted with the stink-bugs, whose popular name is perhaps more descriptive than elegant. They are broad, flat bugs, generally rather large, and mostly dull colored. Most of them are vegetable feeders, although the family contains some predaceous species. One of the worst species of this family with us is the Harlequin cabbage-bug, which sometimes appears in great numbers, and does much damage to growing plants.

Family **Cydnidæ** (Burrowing-bugs). These bugs have a roundish, elliptical body, usually black, or very dark in color, and are found burrowing in sandy places, under sticks, stones, or near the roots or plants.

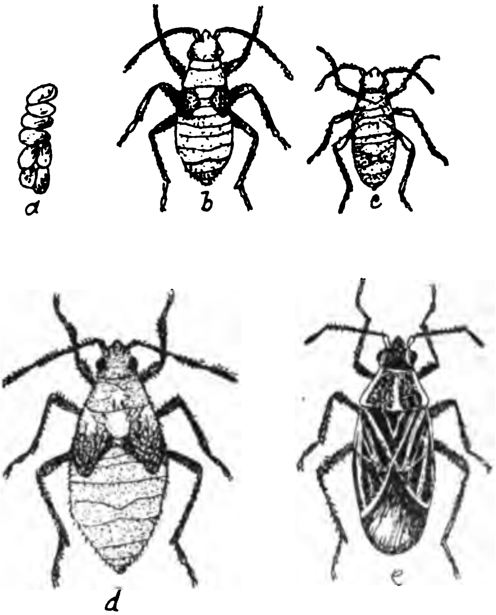


FIG. 45. Box-elder plant bug (*Leptocoris trivittatus*). *a*, eggs, enlarged; *b*, *c*, *d*, different stages of immature bugs, all enlarged. (After Howard.)

Family **Corimelænidæ** (Negro-bugs). These are small, black insects, and are sometimes found in quantity on blackberries, raspberries, and strawberries. They do not confine themselves to these fruits, however, as they sometimes attack potato vines and do much damage.

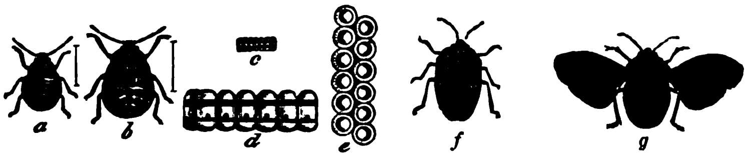


FIG. 46. Harlequin cabbage-bug (*Murgantia histrionica*). *a*, larva; *b*, pupa; *c*, eggs, natural size; *d*, eggs, enlarged; *e*, eggs, seen from above, enlarged; *f*, adult insect; *g*, adult insect, wings expanded.

Family **Scutelleridæ** (Shield-back bugs). This is not a numerous family. They are plant-eating insects, and somewhat resemble the negro-bugs in general appearance.

Suborder **HOMOPTERA.**

The name of this suborder is derived from two Greek words, *homos*, the same, and *pteron*, a wing. Its members differ from those of the other suborder in that the wings are of the same texture throughout, there being no difference in the two pairs of wings. The wings when at rest are usually sloping, like the roof of a house. They have no neck, the head being closely attached to the thorax, and this connection is so close that in many species the beak seems to exude from the thorax itself and to arise from between the fore legs. This suborder is divided into nine families, which are given by Comstock, as follows:

The Cicadas. Family Cicadidæ.
The Lantern-fly family. Family Fulgoridæ.
The Spittle Insects. Family Cercopidæ.
The Leaf-hoppers. Family Jassidæ.
The Tree-hoppers. Family Membracidæ.
The Jumping Plant-lice. Family Psyllidæ.
The Plant-lice. Family Aphididæ.
The Aleyrodes. Family Aleyrodidæ.
The Scale-bugs. Family Coccidæ.

In looking over this list, it will be noticed that here we have a great part of the more injurious pests of the farmer and fruit-grower. In fact, in the whole of this suborder there are not any that are not pests, and many of them the worst of the insect enemies with which we have to contend.

Professor Uhler, our authority in this order of insects, writes that "this grand division of the order contains the greatest number of large species, and the widest range of diversity in the forms of all stages. Comparatively few are destitute of wings, except in one sex of the lowest group; but some have these organs short and unfinished, and it is but very rarely that we meet with one of this kind fully winged. This division is also remarkable for the blunt face and backward pressed elements of the head and breast, thus carrying the rostrum far underneath. Both kinds of eyes are generally present; the compound ones being generally large and prominent, while the single ones, ocelli, are like little convex gems, placed between the larger eyes on the vertex or front, but occasionally, as in Fulgoridæ, on the sides of the cheeks, between the latter and the antennæ. There are usually two ocelli, although in Cicadidæ and most Psyllidæ they are three in number and are placed in front, forming a triangle. The antennæ are usually situated in the hollow between the eyes, and are composed of a few expanded joints at the base, with a tapering, slender, bristle-shaped termination. Exceptions occur in Psyllidæ, Aphididæ, and Coccidæ, where these organs are commonly filiform and somewhat thickened at the tip. There are two principal types of legs in this division, although these are variously modified for particular modes of life, the one being adapted for crawling, the other for leaping. The former have short legs, generally stout; the latter have the hind legs long, often curved and set with rows of stiff spines."

Family **Cicadidæ.** This includes the harvest-flies, seventeen-year locusts, etc. These insects are of large size, and are generally well known. This family has a peculiarity found in no other member of the Hemiptera: the possession of a musical apparatus. The song of the cicada is well known, and is produced by special organs consisting of two large parchment sacs. The surfaces are ribbed and, when in action, the air is forced against these ribbed surfaces, producing sound vibrations and forming the song. It is probable that this "song" is used for the purpose of attracting the female, as these organs are found in the male only. This fact was known to the ancients and an old Greek, Xenarchos, says:

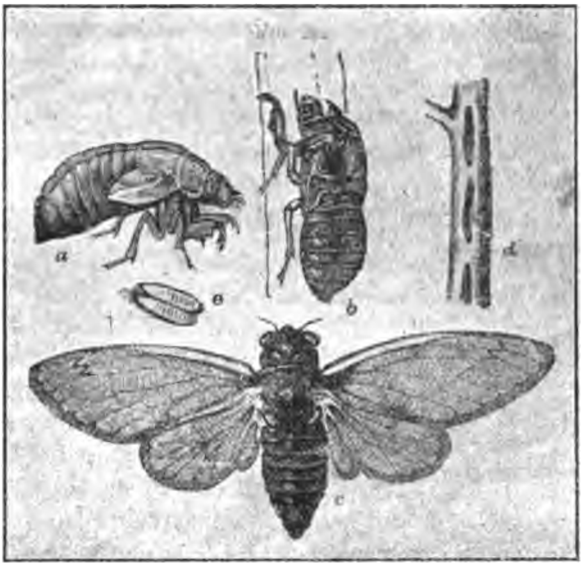


FIG. 47. Periodical cicada (*C. septendecim*). *a*, pupa, ready to change; *b*, pupa skin from which the adult (*c*) has emerged; *e*, eggs taken from the egg-punctures (*d*).

"Happy the cicadas' lives,
For they all have voiceless wives."

The females deposit their eggs in slits which they make in the twigs of trees; these eggs hatch in about six weeks and the young drop to the ground and bury themselves in the earth, where they are supposed to attach themselves to the roots of trees and shrubs, and where they remain until they reach their mature stage, when they force their way from the earth and attach themselves to any convenient object. Here the back of the pupa skin splits and the mature insect, fully winged, creeps forth. It requires some little time for its wings to fully develop, when the newly hatched cicada takes flight to start a new cycle.

The most remarkable thing connected with this family is the length of the larval stage of the two members, known as "Seventeen-year" and "Thirteen-year" locusts. These broods have been watched and recorded by entomologists, and, in one case, they are known to appear in seventeen and in the other in thirteen years. It is, therefore, supposed that their larval, or growing, stage requires seventeen and thirteen years respectively. This is a most remarkable thing in the insect world, as most of these animals have lives of short duration, rarely covering a longer period than a year or two, though this is exceeded in a few instances. But a seventeen-year-old insect is a phenomenon that might be doubted, were it not that the records have been accurately kept and prove it.

Family **Fulgoridæ** (Lantern-flies). In the tropics of South America, members of this family attain great size and are phosphorescent, from which fact we have their common name. The family is represented with us by some small and insignificant species.

Family **Cercopidæ** (Spittle-bugs, Frog-hoppers, etc.). Often during the summer months one will notice masses of froth on shrubbery; upon removing this, a small, soft-bodied insect will be discovered beneath it. Sometimes there will be two or more of these insects under one mass of froth. These are the spittle-bugs, and the froth, which is composed of the sap of the bush upon which they are lodged and which is pumped out by them, is their means of protection. Clear this away a few times and keep the insect clear of it, and it will dry up and die. At its last molt, a clear space under the froth is formed, and the mature insect, no longer needing the moisture for its safety, emerges a perfect frog-hopper, and wanders about the plant.

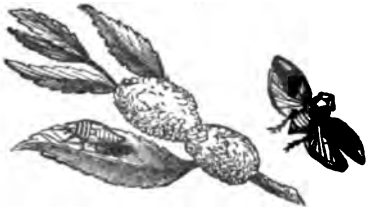


FIG. 48. Frog-hopper or spittle insect (*Aphrophora* sp.). Slightly enlarged.

This is quite a large family, and includes a number of species. All are injurious, where they appear in numbers, as they exist by sucking the juices of the plants upon which they lodge.

Family **Jassidæ** (Leaf-hoppers). This is a family of insects, generally small in size, but very destructive. In this family is *Erythoneura vitis*, the grapevine leaf-hopper, which has a most unfavorable reputation in the raisin vineyards of this State, where it is commonly known as "thrips," although it is not at all related to that insect. During the summer season, they sometimes appear in the vineyards by millions, and by sucking the juices of the vines through the leaves do immense damage. These insects hibernate in the vineyards or vicinity, and under leaves or rubbish, and the best preventive method to be applied against them is to thoroughly clean the vineyard and its neighborhood of all loose rubbish and burn it. By this means the next season's crop of the pest can be greatly reduced.

They are very destructive in meadows, and it is stated that these insects destroy from one fourth to one half of the grass that springs up annually. They are more numerous than any other insect, except, perhaps, the aphids.

Family **Membracidæ** (Tree-hoppers). In this family we find some of the most grotesque forms in the animal kingdom. This is the typical family of the suborder Homoptera. Its members are of every conceivable form, and are described by Prof. Otto Lugger as "arched, compressed, depressed, humpbacked, spindle-shaped, pointed at both ends, inflated, hemispherical or conical, and besides this they are furnished with an endless variety of superficial attachments." They live principally on trees and bushes, and all possess great leaping powers, hence their common name. They are usually not sufficiently numerous to be destructive and have therefore little economic value.

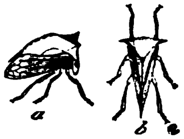


FIG. 49. Buffalo tree-hopper (*Ceresa bubalus*).

Family **Psyllidæ** (Jumping Plant-lice). Members of this family resemble the cicadas in general build, but are much smaller, being from a sixth to an eighth of an inch in length. They differ from the aphids in being of a more solid texture, with stouter legs, the hinder pair being especially strong and fitted for jumping. In their adult form, both sexes are winged. A peculiarity in some of the species of this family is the bifurcated antennæ. In these the feelers are split and end in two bristle-like points. Some of these species exude a honey-dew, and in this respect approach the aphids. The commonest and most destructive member of this family is the pear-tree Psylla (*Psylla pyricola*). This is a very small insect, not over a sixteenth of an inch in length, but it often occurs in such quantities as to do enormous damage to the pear orchards.

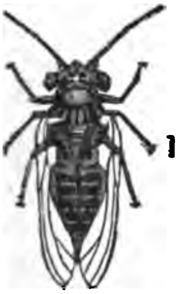


FIG. 50. Pear-tree Psylla) *Psylla pyricola*). Enlarged.

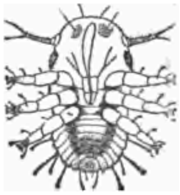


FIG. 51. Larva of *Psylla pyricola*. Enlarged.

Family **Aphididæ** (Plant-lice). This family is closely akin to the foregoing, and in some of its many species is known to nearly every one; to all who have endeavored to grow flowers or vegetables, or who have noticed trees at all. It is a very extensive family, and includes many species, some of which attack most forms of vegetation. In this family we have the phylloxera and the woolly-aphis, and many other well-known forms, all exceedingly destructive to vegetation. The largest species is about a quarter of an inch in length, and from this they range down until it requires a good eye, sometimes assisted by a magnifying glass, to see the smaller members. Some are subterranean, living wholly underground; some are aërial, living on the tops of plants; while some are both, and pass one stage of their existence underground and another above.

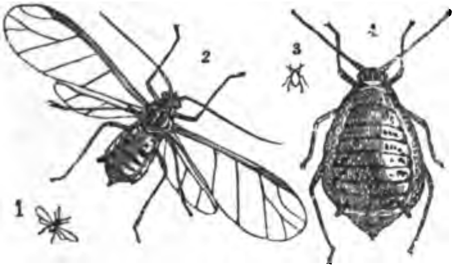


FIG. 52. Aphids or plant lice. Winged and wingless forms. 1 and 3 natural size. 2 and 4 greatly enlarged.

Insects belonging to this family are soft-bodied, gregarious, and most numerous in the wingless form. They have absolutely no means of defense, being destroyed by thousands by every change in the weather, blown to destruction by the winds and washed off by the rains. They have more enemies among predaceous insects than has any other family, being preyed upon in all stages by the lady-birds, which devour them externally, and by Braconids, which devour them from the inside. Many birds eat them, and, being utterly defenseless, they are beset by enemies on every hand. Why, then, are they not exterminated? For the reason that nature has made them so enormously prolific that they are enabled to withstand all the destructive forces which are at work against them, and still leave enough for a new start, for if but a single one is left, that is enough to stock the country with a new brood.

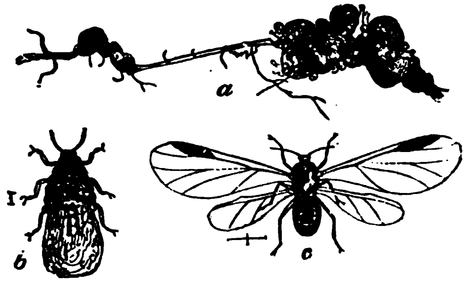


FIG. 53. Woolly aphis of apple (*Schizoneura lanigera*). Enlarged.

The aphis furnishes the most interesting study in the entomological world. It is a contradiction of all known laws in relation to propagation. The first brood, which appears very early in the spring, as soon as there is sufficient plant life to sustain it, is hatched from eggs which have been previously deposited in the crevices of the bark. These are all females. They commence the active work of their lives at once, and suck the plant juices and grow, casting their skin, as they become too large for it, about four times, by which time they have reached adult size and are ready to begin the second great object of their life—that of propagation.

These females give birth to new broods, all of which are still females, and only females are born. This peculiar propagation is continued throughout the summer. In the autumn, however, when the weather grows colder, the last births are both male and female, and these last born females only lay eggs, which remain dormant until the following spring, when they hatch out females, and the same process continues without end.

Some naturalists hold that if the conditions are right the aphis will continue to give birth to females indefinitely without the presence of males. Kyber records having had a rose aphis which produced young for four years, and from his careful experiments it has been asserted that under certain circumstances a female aphis may, in the entire absence of males, continue propagating to infinity, providing that the necessary conditions—food and heat—for the development of the young are not wanting.

The color of the eggs of the aphis, together with their rarity, makes them difficult to discover. During the months of February and March, when the leaf buds of the rose begin to swell, the eggs of the rose aphis may be seen like grains of gunpowder fixed within the crevices of the bark. A single insect hatched from one of those shining black eggs may be the progenitor of many billions of young during her lifetime. Latrielle, who is an authority on this branch of entomology, makes a curious calculation. He says that one female will produce young at the rate of about twenty-five a day during the summer months, and one aphis may be the mother of the enormous number of 5,904,000,000 during the month or six weeks of her existence. Tongard and Morren, equally good authorities, extend this number into quintillions, as being within the capabilities of a single mother's efforts. Professor Huxley makes a calculation which affords an approximate idea of what a quintillion of aphids might mean. Assuming that an aphis weighs as little as the one-thousandth part of a grain, and that it requires a man to be very stout to weigh more than two million grains, he shows that the tenth brood of aphids alone, without adding the products of all the generations which precede the tenth, if all the members survive the perils to which they are exposed, contains more ponderable substance than five hundred million stout men; that is, more than the whole population of China and the United States combined. Fortunately there are large numbers of carnivorous insects which prey upon the aphids and prevent their inordinate increase. The variations in temperature, winds, and birds also have a tendency to prevent their too rapid spread.

We have alluded to the fact that some species of aphids are subterranean, passing their extire existence underground. Among these are the Rhizobiinæ, which are found on the roots of shrubs and plants, and may be very injurious. These never come to the surface, are wingless, and seem to be cared for by ants, which aid in their distribution.

Another underground form is the dreaded *Phylloxera vastatrix*. This pest is known all over the world and has caused millions upon millions of dollars' loss by its depredations in the vineyards of Europe and America. The life history of this pest is given by Professor Marlatt, as follows:

"The life cycle of the phylloxera is a complicated one. It occurs in four forms in the following order: The leaf-gall form (*gallicola*), the root or destructive form (*radicicola*), the winged or colonizing form, and the sexual form. The leaf-gall insect produces from 500 to 600 eggs for each individual, the root-inhabiting insect not much above 100 eggs, the winged insect from 3 to 8, and the last sexed insect but one egg. This last is the winter egg, and may be taken as a starting point of the life cycle. It is laid in the fall on the old wood, and hatches, the spring following, into a louse, which goes at once to a young leaf, in the upper surface of which it inserts its beak. The sucking and irritation soon cause a depression to form about the young louse, which grows into a gall projecting on the lower side of the leaf. In about fifteen days the louse becomes a plump, orange-yellow, full-grown, wingless female, and fills its gall with small yellow eggs, dying soon after. The eggs hatch in about eight days into young females again, like the parent, and migrate to all parts of the vine to form new galls. Six or seven generations of these wingless females follow one another throughout the summer, frequently completely studding the leaves with galls. With the approach of cold weather the young pass down the vines to the roots, where they remain dormant until spring. The root is then attacked, and a series of subterranean generations of wingless females is developed. The root form differs but slightly from the inhabitant of the leaf galls, and the swellings or excrescences on the roots are analogous to those on the leaves.

" During late summer and fall of the second year some of the root lice give rise to winged females, which escape through cracks in the soil, on warm, bright days and fly to neighboring vines. These winged lice lay their eggs within a day or two in groups of two or four in cracks in the bark or beneath loose bark on the old wood of the vine, and die soon after. The eggs are of two sizes, the smaller and fewer in number yielding males in nine or ten days, and the larger the females of the only sexed generation developed in the whole life round of the insect. In this last and sexed stage, the mouth parts of both sexes are rudimentary, and no food at all is taken. The insect is very minute, and resembles the newly hatched louse of either the gall or the root form. The single egg of the larva-like female after fertilization rapidly increases in size until it fills the entire body of the mother, and is laid within three or four days, bringing us back to the winter egg, or starting point.

"This two-year life round is not necessary to the existence of the species, and the root form may and generally does go on in successive broods year after year, as in the case with European vines, on the leaves of which galls rarely occur. Under exceptional circumstances all of the different stages may be passed through in a single year. The young from leaf galls may also be easily colonized on the roots, and it is probable that the passage of the young from the leaves to the roots may take place at any time during the summer. The reverse of this process, or the migration of the young directly from the roots to the leaves, has never been observed."

We have dealt somewhat extendedly with the aphids, because they are among the most serious pests of the farmer and fruit-grower in our own State, as they are elsewhere in the Union.

Family Aleyrodidæ. In the aleyrodes we have a connecting link between the aphids and the scale insects. In the early stages of their lives, the larval form, the aleyrodes are true scale-bugs, and very strongly resemble certain species of Lecaniums. For a long time, members of this family were classed with the Coccids, but owing to very marked differences in the mature insects were erected into a separate family. They are very small insects, and in the larval form are sometimes quite pretty, having a dark center and being surrounded by a fringe of white, waxy filaments. In the mature stage, both sexes are winged, herein differing from the Coccidæ, in which only the male acquires wings. In this stage they are small, white, four-winged flies, very strongly resembling minute moths. The wings and bodies are covered with a whitish powder, resembling flour. We have several species of this family in California, and they may be found quite commonly on the under side of the leaves of fuchsias, nettles, iris, and other plants. Where very numerous, they fly off in a white cloud like a cloud of dust when disturbed. None of our native species are especially injurious, but in Florida and other of the Southern states the *Aleyrodes citri* (the white fly), a species found upon citrus fruits, has proven a very destructive and dangerous pest and one that it has not been found possible to control.

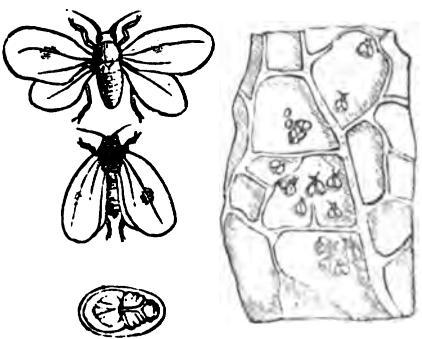


FIG. 54. White flies (*Aleyrodes* sp.). Natural size and enlarged.

Family Coccidæ (Scale-bugs, Mealy-bugs, etc.). We now come to a family more widely known, and, in California, more generally destructive than any other of the insect tribe. It is a very large family, including something over fifteen hundred species, not all of which, however, are found in California.

The family Coccidæ is divided into nine subfamilies, each having its peculiarities of form and habits, which are set forth as follows:

Subfamily **Monophlebinæ.** Of this subfamily, which comprises ten genera, we have a good representative in *Icerya purchasi* (the cottony-cushion scale), which is well known to almost every horticulturist in California. The general characteristics are: Males with compound eyes. Females with definite hairy anal ring. The insects are usually covered by a cottony matter of several shades of color and with a secretion of still longer filaments. Skin with rounded spinnerets and with long, scattered hairs. The lateral lobes of the extremity of the abdomen are fitted with a series of long, interlaced bristles.

Subfamily **Margarodinæ.** This subfamily has been erected to accommodate a single genus—Margarodies—comprising about ten species. This subfamily is not represented in California. One very pretty species is found infesting roots in South Africa and is bead-shaped. They are very brilliant in color, being somewhat of a metallic green, and are collected by the natives, strung on stout thread and worn as ornaments.

Subfamily **Orthezilinæ.** Under this subfamily are included three genera, of which the genus Orthezia is the most important and the only one represented in California. The female presents the following characters: Eyes simple, anal ring with hairs. Body more or less covered with cereous matter arranged in compact symmetrical plates. The eggs are carried in an elongated ovisac, which projects behind the body until they hatch. Insect active throughout entire life. Legs long, with fine hairs, one claw, and no digitules. Two or more long, slender, snow-white filaments project from near the posterior end. Color usually white.

Subfamily **Phenacoleachilinæ.** This subfamily was erected to accommodate a single genus—Phenacoleachia—and is represented by a single species, which occurs in New Zealand on *Cupressus* sp.

Subfamily **Conchaspinæ.** These are insects with a separate covering scale, which is formed entirely of secretionary matter, not using the cast skins (exuviæ) in forming the covering scale. Adult females retain limbs and antennæ. A distinguishing feature of this subfamily is to be found in the mouth parts, as the lower part of the mouth (mentum) is composed of two parts, and is grooved out to accommodate the sucking tube of the insect. This subfamily contains but a single genus—Conchaspis—of which only four species have been recorded, none of which occur in California.

Subfamily **Dactylopiinæ.** This subfamily includes a large number of genera, something like fifty-two, of which thirteen occur in California. Among those found in this State are the following: Asterolecanium, Pollinia, Kermes, Nidularia, Gossyparia, Eriococcus, Dactylopius, Ceroputo, Pseudococcus, Erium, Ripersia, and Antonina. The most important of these is the Pseudococcus (mealy-bugs). The following may be of assistance in placing the species in their proper place: Abdominal extremity not cleft, usually with a pair of more or less prominent rounded tubercles, each bearing a long seta. No hinged plates above anal orifice. Larva with abdominal lobes. Female not secreting a waxy scale.

Subfamily **Tachardiinæ.** These insects are inclosed in a resinous cell, with three orifices. Adult female without legs, with the terminal segments produced into a tail-like organ, with the anal orifice at the extremity, which is surrounded by a broken hairy ring. A spine-like organ above the base of the caudal extension. This subfamily includes but two genera, comprising about twenty-three species, and is not represented in California.

Subfamily **Coccinæ.** This is another large subfamily, embracing some forty-eight genera, ten of which are represented in California, viz.: Pulvinaria, Exæretopus, Ceroplastes, Vinsonia, Eucalymanatus, Coccus, Eulecanium, Saissetia, Physokermes, and Aclerda. The main characters of the Coccinæ are as follows: Females keeping the form of the body, with segments distinct until the end, and also retaining the power of moving under certain circumstances while young. Either naked or simply covered with waxy filamentary material. Most of the females, after impregnation, take on a different form and become fixed to the host plant, and, once fixed, remain so for the rest of their lives. Under this subfamily are grouped some of the more destructive forms with which the fruit-growers of California have to contend. The principal ones being *Saissetia oleæ* (black scale), *Pulvinaria innumerabilis* (cottony maple scale), and *Coccus hesperidum* (soft orange scale), although this species is now not considered a pest.

Subfamily **Diaspinæ.** These insects have a separate covering-scale composed partly of secretionary matter and partly of the exuviæ, which are the discarded skins shed at the periodical molts of the insect. Adult female without limbs. The form of the scales comprising this family are usually circular, varying to oblong. The eggs are deposited beneath the parent scale. Under this subfamily occur some thirty-five genera, among which are to be found many of the most destructive species in our State. The principal ones are Chionaspis, Diaspis, Aulacaspis, Hemichionaspis, Fiorinia, Aspidiotus, Chrysomphalus, Pseudaonidia, Lepidosaphes, and Parlatoria.

In treating of the different species of the scale-bug family, it will be well to call attention to the new classification. Our Horticultural Commissioners have struggled hard, in most cases, to inform themselves in regard to scale pests in California, and have learned to know them by their old names. Now, these names have been largely changed, the knowledge acquired by our commissioners is turned topsy-turvy, and they will have to learn the names of their old acquaintances over again, or fail to recognize them when they appear in print. Following is appended a list of the changes which have been made in the nomenclature of the more common of our California scales.

Common Name.	*New Name.*	*Old Name.*
Mealy-Bug.	Pseudococcus.	Dactylopius.
Black Scale.	Saissetia oleæ.	Lecanium oleæ.
Soft Brown Scale.	Coccus hesperidum.	Lecanium hesperidum.
Hemispherical Scale.	Saissetia hemispherica.	Lecanium hemisphericum.
Apricot Scale.	Eulecanium armeniacum.	Lecanium armeniacum.
Frosted Scale (Prune Scale).	Eulecanium pruinosum.	Lecanium pruinosum.
Red Scale.	Chrysomphalus aurantii.	Aspidiotus aurantii.
Yellow Scale.	Chrysomphalus citrinus.	Aspidiotus citrinus.
Oleander Scale.	Aspidiotus hederæ.	Aspidiotus nerii.
Purple Scale.	Lepidosaphes beckii.	Mytilaspis citricola.
Long Scale.	Lepidosaphes gloverii.	Mytilaspis gloverii.
Rose Scale.	Aulacaspis rosæ.	Diaspis rosæ.

These are a few of the changes that have been made in the nomenclature of this family, and the list presented above will aid our commissioners and those who learned under the old school to recognize their old friends under their new names.

In many members of this family there seems to be a sort of retrogression, and they go from bad to worse, from the time they are hatched out until they die. When first hatched they are perfectly formed insects, having the required six legs, well-formed antennæ, eyes, and mouth parts. They are lively in their motions and get around at a fairly good rate. In a short time, however, they settle down in a chosen place, on some form of vegetable, insert their beak and suck. Having no further use for legs and other organs needed in active life, they gradually lose them, molting in the meantime, and forming the coating which we know as a scale. In the last stage, however, there is a difference between the two sexes, for while the female never changes her position, being converted as it were into a mass of eggs and young at the end of her life, the male emerges from the scale form a perfect insect; usually a very pretty little creature, with a full complement of feet and wings, and all other organs except mouth parts. He can no longer eat, and is therefore not to be feared. His mouth parts disappear and in their places he acquires a new pair of eyes. This we presume is the better to enable him to find the female, for this is now all that is left in life for him, and he soon passes away.

This description will hardly apply to members of several of the subfamilies, in which both sexes retain some powers of locomotion through life and do not become fixed, nor form a scale. A peculiarity of this family, too, is that while they belong to the four-winged insects, the perfect males have but one pair of wings, a pair of small hooks, known as halteres or poisers, taking the place of the other pair, and, unlike other members of this order, the males undergo a complete metamorphosis.

As the Coccidæ are treated of *in extenso* in another part of the present publication, under the title of "The Coccidæ of California," we will dismiss this family here, and refer our readers to that paper for a full account of them.

Order **NEUROPTERA.**

(The Nerve-winged Insects.)

In the old classification, this order included all insects with four more or less transparent wings, and these veined or netted. The lace-winged fly and the dragon-fly were marked types of the order. In all members the mouth parts are formed for biting. Aside from the winged resemblance, however, there were such marked differences in the diverse members of this order that several new orders have been constructed from it, and it is divided into from two to five minor orders, according to the importance attached by authorities to the development of different organs, and especially in relation to different methods of transformation. This order, or group of orders, is not of great importance to us, for aside from some beneficial insects which we find in it, the greater portion are neither beneficial nor injurious; we may therefore consider its members together under the old style.

In this order both pairs of wings are usually of the same size and of a similar membranous texture, and traversed with nervures, which are usually united by a number of smaller ones, so that the wings present a net-like appearance. In some of the members the metamorphosis is complete and in others incomplete, and upon this fact the order has been divided. The Neuroptera proper are divided into seven families: Mantispidæ, Raphidiidæ, Sialidæ, Coniopterygidæ, Myrmeleonidæ, Hemerobiidæ, and Chrysopidæ.

The family **Mantispidæ** is so named from the fact that the insects strongly resemble the praying mantis in the order Hemiptera. They are much smaller insects, however, and their possession of four strongly marked membranous wings gives them a place in the order under discussion. They have strong, grasping forelegs and are predaceous, living upon other insects. Only one member of this family is known in California, *Symphasis signata*, but it is not frequently met with.

The family **Raphidiidæ** is represented in California by an insect about half an inch in length, with a peculiarly shaped head and neck which protrude far in advance of the wings. It is a predaceous insect, lives largely on the larvæ of the codling-moth, and is one of the best of the native parasites of this pest. It is not a common insect, but is sometimes found under the bark of trees, where it takes refuge.

The family **Coniopterygidæ** comprises a few rare insects which have no economic importance, and are of interest only to the systematist.

The family **Sialidæ** includes the Dobson fly, which, in its larval form, serves as a bait for anglers. In this stage it is an aquatic insect, living upon other water insects. It has no economic value.

The family **Myrmeleonidæ** are the doodle-bugs, or ant-lions. They have the peculiar habit of setting a trap for their prey, usually in the path of the ants, and this they do by digging a pit in the shifting sand. When an ant gets over the edge of this pit he rolls to the bottom, where the doodle-bug grasps him in his jaws and sucks out the juices. In their matured form they strongly resemble dragon-flies.

The family **Hemerobiidæ** strongly resembles the lace-winged flies in appearance, but much larger and differently colored, being usually dark brown. They are predaceous, and, so far, beneficial.

The family **Chrysopidæ** includes the lace-winged flies, so well known to our orchardists. In their larval form they are commonly known as aphis-lions, from the fact that they are largely predaceous on aphids. The mature insect is a very pretty creature, with its delicate form, gauzy wings, and brilliant, prominent golden eyes. Upon being disturbed they emit a disagreeable fetid odor. Their eggs are white, are supported on long stalks, and are usually deposited on plants infested with aphids. The larvæ are active and extremely voracious. There are two or more broods during the summer, and the last brood winters in the pupa state protected by a compact, round, whitish cocoon.

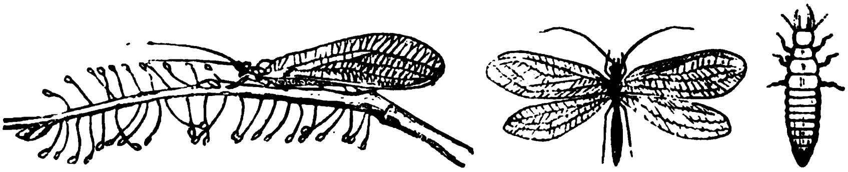


FIG. 55. Lace-winged fly.

There has been much confusion among entomologists in regard to the insects comprising this order, owing to the diversity of character of many of the insects classified under it originally, and this has resulted in splitting it up into several minor orders, some of which are represented by a single family. Some authorities divide it into two suborders, the true Neuroptera and the Pseudo-neuroptera. In the former the metamorphosis is complete, and in the latter it is incomplete. In this classification of Neuroptera and Pseudo-neuroptera, the insects with incomplete metamorphosis are separated into *Ephemeroptera*, or mayflies; *Odonata*, or dragon-flies; *Plectoptera*, or stone-flies; *Platyptera*, the white ants, book-lice, and bird-lice. Comstock, however, erects separate orders for these, and does not recognize the Pseudo-neuroptera. As few of these are of great economic importance, and as this is not a scientific treatise, we give the minor orders place under the general title of Neuroptera.

Order **Mecoptera** includes but one family, the scorpion-flies, so-called because the last abdominal segment has a strong resemblance to the sting of the scorpion. It is not a sting, however, and contains only a set of grasping organs. These insects are of no economic importance.

Order **Trichoptera,** the caddice flies, in their larval stage, are found in streams and have the peculiarity of constructing for themselves shelters of particles of wood, gravel, and other substances. The larvæ remain in these structures, the head alone protruding, and are thus safe from outside foes. The material of which these structures are joined together is a silk spun by the worm, and the inside of the tubes is generally lined with the same substance. Another peculiarity of these insects is that under water they construct a web very similar to that of the spider on the surface.

Order **Ephemerida** includes the mayflies, which are very delicate insects that appear in enormous numbers on summer evenings on the margins of quiet streams and lakes. The mayfly is an aquatic insect, and spends its entire larval life in the water. In its perfect form it is a beautiful sprite-like insect, without mouth parts, its only object in life being to lay the eggs which are to produce a new generation. This is accomplished in a few hours and the insect passes away. They have no economic value. The metamorphosis is incomplete.

Order **Odonata** (Dragon-flies). Members of this order are easily recognized and are well known. They are, in their larval form, aquatic, and have an incomplete metamorphosis. They may be classed as beneficial, as they live almost wholly on mosquitoes in both their larval and mature stages, and are probably one of nature's most effective methods of keeping down these troublesome pests. Unfortunately, this insect has been credited with malign powers, and ignorant people regard it as a dangerous insect. It is at once one of the most graceful, beautiful, useful, and harmless of the insect tribe. It has no sting and no means of defense, except in its rapid flight, and may be handled with impunity by collectors. Aside from their work on mosquitoes, members of this order have no interest to our orchardists.

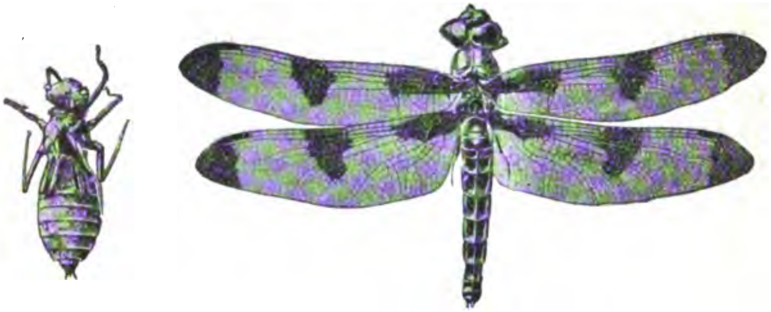


FIG. 56. Dragon-fly. Natural size.

Order **Plecoptera** (Stone-flies). These are insects having an incomplete metamorphosis, and which breed in great numbers in streams. They are known as stone-flies from the fact that they take refuge under stones in the streams, and are a favorite bait with anglers. Fish are very fond of them, but aside from this they are of no economic importance.

Order **Isoptera** includes the so-called white ants, or termites, which, by the way, are not ants at all, nor even remotely connected with them. Termites are very common insects in California, where they will be found working usually on decaying wood, but sometimes attacking growing trees just beneath the surface of the ground. They are not, however, seriously harmful, and while some damage is reported from their attacks, this is not common. This order comprises some of the most remarkable and interesting forms of insect life, and it may be well to

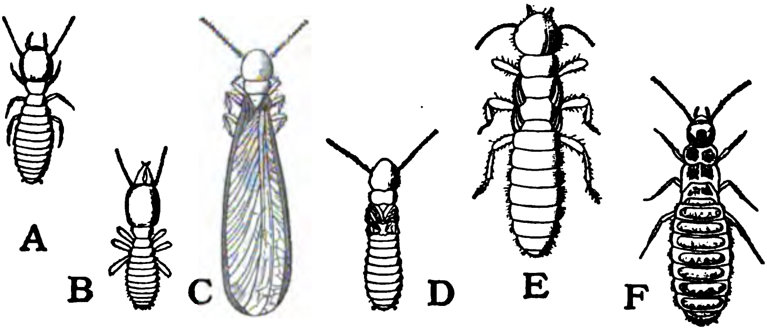


FIG. 57. Various forms of *Termes lucifugus*. A, adult worker; B, soldier; C, perfect winged insect; D, perfect insect after shedding the wings; E, young complementary queen; F, older complementary queen. Enlarged. (After Grassi and Sandias.)

deal more extensively with it. There are seven species found in the United States, of which four are confined to the Pacific Coast. None of these are of large size, usually being from one sixth to one fourth of an inch long. In the tropics, however, they attain a much larger size, and are among the most destructive of insects, in some cases being so destructive to wood that this material can be used very sparingly, if at all, in buildings. Comstock gives the following account of the life of the termites:

"A remarkable thing about the white ants is the way they are divided into classes, each class fitted to do a certain work for the colony. *First*, there is the class of workers, which is constituted of both sexes; they are wingless and of a dirty-white color, and while they resemble true ants somewhat, their waists are thicker. Their business is to bring food for everybody, feed and bring up the young termites, and build nests. *Second*, there is the class called soldiers; these, too, are of both sexes, and wingless, and look somewhat like the workers, only their heads are tremendous in size, being often nearly as long as the rest of the body, and their jaws are large and powerful. *Third*, is the royal class, called *kings* and *queens*. It would have been better to have called them fathers and mothers, as they are the parents of the colony, and do not rule it. This class when grown have wings, which lie flat upon the back when at rest, and may be twice as long as the body. In May or June in our common species this class swarms forth from all the nests of the neighborhood. After a flight of some distance the wings are shed, and a king chooses some queen near him and proposes that they start a kingdom of their own. But like mortal kings and queens they can not reign unless a kingdom is found for them, and so millions of these royal pairs die because they have no subjects. But sometimes a fortunate couple is discovered by some termite workers, who at once take possession of the wanderers and provide them with food and with shelter in the shape of a large circular shallow cell. In this they are really imprisoned, but are well cared for. Soon the queen or mother begins to develop eggs, and her body grows enormously. Finally, it is nothing but a huge sac filled with eggs, looking more like a potato than anything else, and is sometimes six or seven inches long. Of course, the poor queen can not move herself in the least, and if she were not fed would soon starve; but her king remains devoted to her, and her ladies and gentlemen in waiting do their best to make her comfortable; they carry away the eggs to other chambers as soon as they are laid, then care for the eggs, and feed the little ones when they are hatched. The young termites are active, and resemble the adult in form. If a nest becomes queenless, and the workers are unable to procure a queen, there are developed in the nest wingless sexual individuals, which are termed complemental males and females. But as each complemental female lays only a few eggs, it requires several to take the place of a real queen.

"All white ants are miners, and avoid the light. They build covered ways wherever they wish to go. In hot countries they are a terrible pest, as they feed upon wood, and actually destroy buildings and furniture and libraries. They leave merely the outside portion of what they feed upon; and they have been known to enter a table through the bottom of the legs and to eat all the inner portions so that a slight weight crushed it to the floor. In Florida they do damage to orange and other trees by girdling them below the surface of the ground."

Order **Corrodentia** (Book-lice, etc.). These are tiny creatures, somewhat resembling the termites in appearance, only one family of which, the Psocids, are found in the United States. They are general scavengers and receive their common name of book-lice from the fact that they are sometimes found in libraries, attacking old and unused books. They are found in great numbers in many of our orchards, where they congregate in colonies. They lay their eggs in heaps on leaves and branches, and cover them with a web, giving vegetation a dirty appearance, as the dust finds lodgment on these webs. The dry climate of California is especially favorable to their propagation, but, aside from the fact that they give our trees a dirty appearance, they are of no importance to us from an economic standpoint.

Order **Malophaga.** This order has been erected for the bird-lice. We have alluded to these insects before, and little more need be said of them. They infest birds and sometimes are also found on animals, being known by the name "wool-eaters," which was given them because some species are found on sheep and goats. They are furnished with mandibulate jaws, and are, therefore, biting and not sucking insects. In this they differ from the true lice, which are suckers. Their metamorphosis is incomplete.

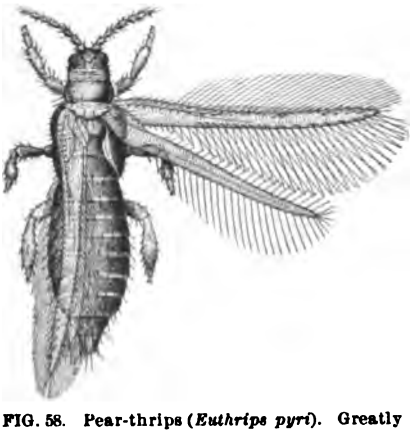


FIG. 58. Pear-thrips (*Euthrips pyri*). Greatly enlarged.

Order **Physopoda** (Thrips). This is a small order of very small insects which has had a deal of trouble in getting located. Entomologists have located it in the Hemiptera, the Orthoptera, and the Neuroptera. Finally a "Thysanoptera" was created to take care of it, and now it has come to be known as Physopoda. Whatever the name of this group, its members while exceedingly minute are also exceedingly destructive. The various species in this order are distinctly different from those belonging to any other order, which accounts for the trouble of locating them when there were only the seven orders in which to place all insects, and the necessity at last of erecting an order for them.

These insects abound in flowers and flowering plants and can be found in great quantities in many blossoms. In some sections they infest pear, orange, and other fruit trees, and do much damage by injuring the blossoms, as they bite into the essential organs and prevent the fruit blooms from fertilizing and the fruit from setting. In the vineyards of this State one of the leaf-hoppers is called a thrips, but this is a misnomer, as the insect found in the vineyard is a hopper, and belongs to the Homoptera.

Order **LEPIDOPTERA.**

(Butterflies and Moths.)

A description of the members of this order is hardly necessary, as it is the best known of all the insect tribe. The butterflies are especially attractive to the non-scientific classes, as they comprise the most attractive and showy of all insects. We find them of all colors and all combinations of color, and of such varied forms that one becomes bewildered with their myriad beauties. They have been aptly termed the flowers of the insect world, and, certainly, in their varied hues and forms, they more resemble flowers than animals. Their name, Lepidoptera, is composed of two Greek words, *lepis*, a scale, and *pteron*, a wing, and means scaly wings, from the fact that the wings, in insects belonging to this order, are covered with minute scales.

As a rule, it is not difficult to recognize a member of this order, for while the species are very numerous, there are conspicuous general characteristics in shape, wing formation, etc., which are so strongly marked as to make them plainly recognizable even to the tyro. There are, however, some minor exceptions to this statement in the wingless forms, usually females, as the tussock-moth, the cankerworm, etc., and in the clear-winged moths, which so nearly resemble wasps that the beginner in entomology might be pardoned for mistaking them.

The order is again divided into two well-defined groups or suborders: the moths, or Heterocera, meaning variable horns, from the great variety of forms shown in their antennæ, and the butterflies, or Rhopalocera, or club-horns, in allusion to the form of their antennæ. The butterflies are all diurnal, or day-fliers, while the greater part of the moths are nocturnal, or night-fliers. Some moths fly in the daylight and many are on the wing during the twilight hours, between sundown and dark, but by far the greater part of the members of this family are night-fliers.

Referring again to the antennæ, there is always a distinguishing feature here by which we can decide to which class either of these insects belongs, for while moths and butterflies, in some of their forms, so nearly approach each other that it is difficult to tell where to place them, the antennæ of the butterfly invariably end in a little club or knob, hence the name. The antennæ are always filiform, or thread-like, varying in thickness; but at the end there will be a knob, which is sometimes prominent, sometimes obscure, and varies in form in different species, but it is always present. With the moths, the antennæ always end in a point. In this group, there is a great variation in the form of the antennæ; they are feathered or branched, or filiform, sometimes very simple and sometimes very elaborate, but they invariably terminate in a point.

While, in their perfect state, this order is the most attractive of all the insect tribe, they are, in their larval stage, the most destructive of any. With the exception of the silkworm, whose products we have turned to our use, and a few minor species which are predatory, we may say that the whole order is destructive. They are vegetable feeders, and, in the form of caterpillars, often do enormous damage. Codling-moths, armyworms, cutworms, cankerworms, gypsy-moths, the brown-tail moths, and others of this kind, are too well known to our orchardists, while the housewife is troubled out of her life by the clothes-moth. They are a pest in everything, and do more damage than any of the other insect orders.

Another distinguishing feature is that, when at rest, the butterflies fold their wings perpendicularly over their backs, while the moths fold theirs horizontally. In the latter, the wings lie flat on the back, or are folded over it roof-like. There is one family of butterflies, commonly known as skippers, which seems to connect the two branches, and in these one pair of wings are folded, as in the butterflies, and the other lie flat, as in the moths.

The butterflies have well-marked peculiarities which separate them into natural groups, based on the character of the feet and the position of the antennæ. In the true butterflies, the head is very narrow, and the feelers are set close together on the top. The club on the antennæ is very prominent and well defined. In the skippers, which we have stated seem to form a connection between the two suborders, the head is much broader, the bodies stouter, and the antennæ, while ending in a club, are recurved and pointed, and they are widely separated and set close to the eyes.

It has been previously stated that all insects have six feet, from whence we have the name Hexapoda, applied to this section of the insect world. In the case of some of the butterflies, it would seem at first glance that an exception was had to this rule. In many of them the fore legs and feet are aborted, and often not plainly visible. They are always present, however, even if indistinct. In these, the tibia or foot is represented by a brush, and these brush-footed butterflies are divided into two families: the Nymphalidæ, containing the moderate-sized and large species, and the Lycænidæ, small species, generally of a blue or coppery color, with the under side sometimes marked with hair-like streaks. These are commonly known as the blues, coppers, or hair-streaks. They are common in damp places and along watercourses.

There is a marked difference in the methods of transformation in the butterflies and moths. In the former, the pupa is known as a chrysalis; it is naked—not inclosed in a cocoon—and is always above ground, there being no subterranean forms. Usually the chrysalids are found attached to the under side of a limb, a stone, or some other convenient place, and usually pendent. They are, as a rule, obscure in color, although some are brilliantly marked with metallic colors, and some are ornamented with points like burnished gold.

The pupa of the moth is inclosed in a cocoon. This may be a silken web woven round it for its protection, the highest form of which we find in the cocoon of the silkworm, or it may be a mere case of hardened earth, silk-lined and buried.

The moths vary much more in their habits than do the butterflies, and are found in all places. Some are wood-borers, and pass their transformations in the trunks of the trees which have given them refuge; others are subterranean in their larval stage, and these construct cells of earth in making the change; others are plant feeders, and these may weave a cocoon in any available place. The butterfly is wholly aërial. Its larva is always found on the surface. It is not a borer or a burrower, with perhaps the exception of the genus *Megathymus*, one of the skippers, which in its larval stage is said to burrow in the underground stem of the yucca.

In the Lepidoptera the three principal divisions of the body are well defined. The head is small, rather broad in proportion to its length, and moves freely on the neck. The eyes are hemispherical and very prominent, of various colors in the different species, and sometimes showing a few hairs. Two ocelli are found in some of the moths, usually concealed beneath the hairy scales which cover the head, and are probably of no service as visual organs.

In their larval form, members of this order are popularly known as caterpillars, but the smooth species are often termed worms—which, by the way, like most popular names, is a misnomer—as cankerworms, apple-worms, cutworms, budworms, etc. They vary very much in size, form, and appearance, according to species. The body is usually cylindrical, and is composed of twelve rings or segments, besides the head. The head is the most specialized part of the larva. It is usually covered by a horny plate, often divided down the middle into two equal parts. The jaws are broad and strong, serrated or toothed on the edges, with the under lip or labium well developed, while the maxillæ and palpi in most species are rudimentary. They differ very greatly from the mature insects; in fact, it may be said that they do not resemble them in any respect. In the larval form, caterpillars are vegetable feeders and are very destructive; their mouth parts are formed wholly for biting and chewing, while, in the perfect insect, these are entirely changed, and it lives by suction. The internal organs and all the external organs are changed in the process of transformation.

The first three segments behind the head are the thoracic segments, and these carry the jointed feet, which afterwards develop into the feet of the mature insect. These are known as the true legs. The remaining segments, usually nine in number, are known as the abdominal segments, and on these we find the false or prolegs, varying in number from two to five pairs. These are provided with a circle of minute hooks, in the place of feet, which enable the caterpillar to cling fast to the plants upon which it feeds. These prolegs disappear in the mature insect. Most caterpillars have sixteen legs, including the true and false legs. The loopers, or measuring-worms, however, have but ten, while the bag-worms have but six.

Suborder **RHOPALOCERA.** (Butterflies.)

While the moths are the most important branch of the Lepidoptera, greatly exceeding in number of families and species the butterflies, and are of much greater economic importance from either a beneficial or an injurious standpoint, yet the former are the more widely known and admired largely owing to the nocturnal habits of the greater part of the moths, and also to the fact that a very large portion of them are obscure in coloring, while nearly all the butterflies are attractive.

Butterflies are separated into five families, representatives of all of which are found in California. These are:

1. Nymphalidæ, the Brush-footed Butterflies.
2. Lemoniidæ, the Metal-marks.
3. Lycænidæ, the Blues, Coppers, and Hair-streaks.
4. Papilionidæ, the Swallow-tails, etc.
5. Hesperiidæ, the Skippers.

The family **Nymphalidæ** is distinguished from all other butterflies by the fact that in both sexes the first or prothoracic pair of legs is greatly dwarfed, useless for walking and carried folded up against the breast. On this account, members of this family are sometimes known as four-footed butterflies. It is the largest of all the families, and has been divided into many subfamilies. It is generally composed of large or medium-sized insects, but there are some small species in it. Prominent in this family is the large Milkweed butterfly, or, as it is sometimes called, the Monarch (*Anosia plexippus*). This is a cosmopolitan insect, and is found nearly the world over. It is very common in California, and can often be seen on a summer day flying westward in large numbers. It is a large, red-brown insect, with the wing veins very broadly marked in black. The caterpillars, which are common on the milkweeds, are about an inch and a half in length, when fully grown, greenish in color, marked with black bars. It is pretty, even in its larval form, and the chrysalis is a most striking object, being marked with brilliant golden dots along the margin.

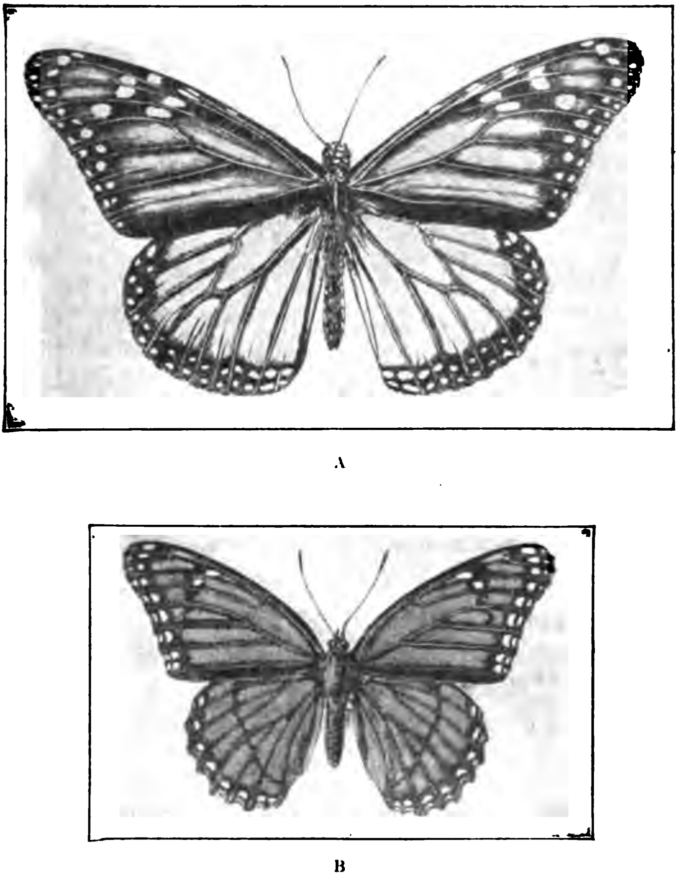


FIG. 59. A, *Anosia plexippus*, the "model"; B, *Basilarchia archippus*, the "mimic." Natural size.

Family **Lemoniidæ.** Butterflies belonging to this family are mostly confined to the new world, and largely to the tropical sections. Its distinguishing features are that the males have but four walking feet, while the females have six, and the antennæ are longer than in the first-named family. They are usually small insects, but are very brightly colored.

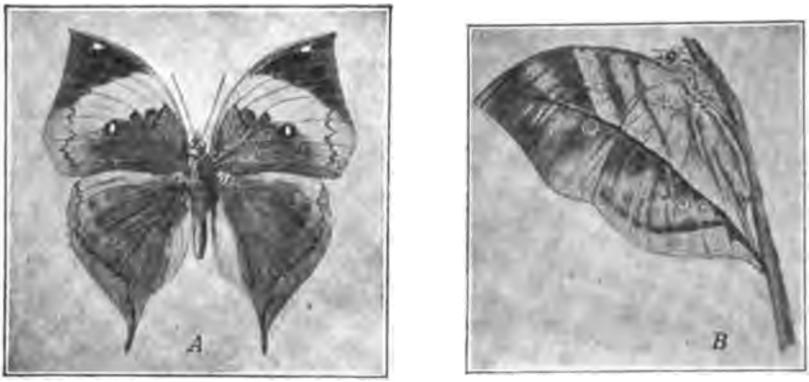


FIG. 60. *Kallima inachis*. A, upper surface; B, with wings closed, showing resemblance to a leaf.

The family **Lycænidæ** is a very large one of mostly small butterflies, and contains some of the most beautiful members of the order. Blue in various shades is a common color. In this family the males have four and the females six walking feet.

Family **Papilionidæ** (Swallow-tails). In this family both sexes have six feet, and in it we find some of the largest and most striking forms in our State. One of the most common and showy of this family in our State is *Papilio turnus*, the large yellow swallow-tail, with a spread of wings over four inches. (See colored Plate I.) The ground color of its wings is bright yellow, crossed with broad dashes and streaks of black, with black border, inclosing crescent-shaped markings. Near the tips of the hinder wings are bright purple and yellow marks, which add to the beauty of this grand insect.

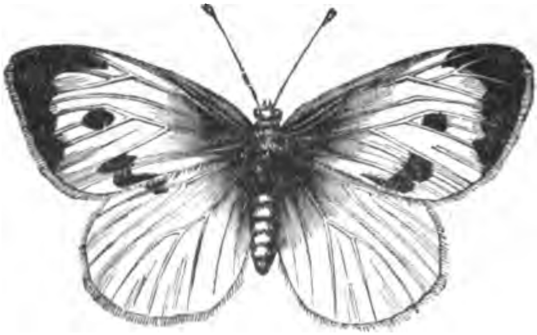


FIG. 61. Large white cabbage butterfly (*Pieris brassicæ*).

A second group of this family is the *Pierinæ*, which include the well-known cabbage-butterfly (*Pieris rapæ*). This is one of the worst pests of all the butterfly tribe. It was imported from the Mediterranean region into Canada about the year 1868, and since that time has spread all over the American continent. It will be found in swarms over cabbage patches, alfalfa fields, and other sections, in which it finds its food plants, until the fields sometimes have the appearance of being in a snow storm. Its larva is the common green cabbage caterpillar. In connection with the cabbage whites, we often find a bright yellow butterfly, known as the sulphur yellow. These belong to the genus *Colias* and are very common in alfalfa fields, as the larvæ feed upon clover. It is a green worm, very similar to the cabbage-worm, and so nearly the color of its food plant as to be difficult to find. In this State it feeds largely upon alfalfa, and while it does some damage to this crop, can not be regarded as a very serious pest.

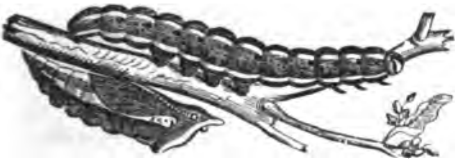


FIG. 62. Larva of *Pieris brassicæ*.

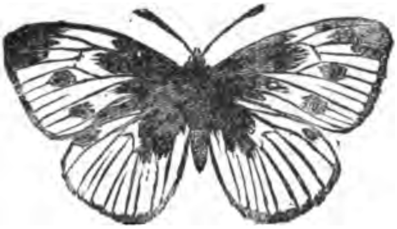


FIG. 63. Small white cabbage butterfly (*Pieris rapæ*).

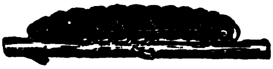


FIG. 64. Larva of *Pieris rapæ*.

Family **Hesperiidæ** (Skippers). This family is of little economic importance to us. The genus *Megathymus* is said to have the habit, in its larval stage, of burrowing in the underground stems of the yucca, and, therefore, is somewhat of an anomaly among butterflies, as it is the only one which works beneath the surface. The family is interesting in the possession of certain characteristics which seem to connect the butterflies with the moths. Members of this family are small, with stout bodies, quick and powerful in flight, and have a peculiar jerky motion, from which their common name is derived. They have six well-defined feet in both sexes, and in their metamorphoses weave a light cocoon of a few silk threads, in this, as in many other respects, approximating the moths.

In North America alone there are over six hundred and fifty species of butterflies, but all belong to one or another of the families named.

Suborder HETEROCERA. (Moths.)

We now come to the second and more important division of the order Lepidoptera, the *Heterocera*, or moths. The species included under this division are far more numerous and of greater importance in every way than are those classed as butterflies. Among the moths we find some of our most important insects from an economic standpoint; some few are also beneficial, as predaceous upon other pests; but by far the greater part of them are injurious to a greater or less degree, and some of them are among the most destructive, costly, and serious of all our insect enemies. The codling-moth, together with its destructive work, is well known to orchardists, and the bee-moth is a terror to the apiarist, methods to circumvent its destructive work racking the brains of our beemen. The Mediterranean flour-moth has, on many occasions, put large and costly flouring-mills out of business by so obstructing the machinery with its webs that it could not be operated. The clothes-moth and its destructive work are well known to every housekeeper, and so the list might be almost indefinitely extended.

As stated before, as most of these insects are nocturnal they are not so well known as the butterflies, which fly only in the light, but they are by far the more numerous, covering a wider range of families and species, and working their destructive operations in more diverse ways than the other members of the order.

The moths with which we are acquainted in the United States are divided into forty-three families, as follows:

1. Sphingidæ.
2. Saturniidæ.
3. Ceratocampidæ.
4. Syntomidæ.
5. Lithosiidæ.
6. Arctiidæ.
7. Agaristidæ.
8. Noctuidæ.
9. Nycteolidæ.
10. Pericopidæ.
11. Dioptidæ.
12. Notodontidæ.
13. Thyatiridæ.
14. Liparidæ.
15. Lasiocampidæ.
16. Bombycidæ.
17. Platypterygidæ.
18. Geometridæ.
19. Epiplemidæ.
20. Nolidæ.
21. Lacosomidæ.
22. Psychidæ.
23. Cochlidiidæ.
24. Megalopygidæ.
25. Dalceridæ.
26. Epipyropidæ.
27. Zygænidæ.
28. Thyrididæ.
29. Cossidæ.
30. Ægeriidæ.
31. Pyralidæ.
32. Pterophoridæ.
33. Orneodidæ.
34. Tortricidæ.
35. Yponomeutidæ.
36. Gelechiidæ.
37. Xylorictidæ.
38. Œcophoridæ.
39. Blastobasidæ.
40. Elachistidæ.
41. Tineidæ.
42. Hepialidæ.
43. Micropterygidæ.

Family **Sphingidæ** (Hawk-moths). These moths fly at twilight, and are very noticeable because of their habit of hovering over flowers, from which they extract nectar by means of their extraordinary tongue, which is sometimes several times the length of the insect. Its larva is the large green worm often found on tomatoes, grapes, tobacco, etc. The caterpillars are peculiar in the possession of a sharp, curved horn on the last segment of the body, or in its place a hard eye-like spot. When at rest, some of them have the habit of elevating the body and drawing back the head, giving them somewhat the resemblance of the Sphinx, from which they take their name. Some of the largest of the moths are found in this family, which includes many genera and species.

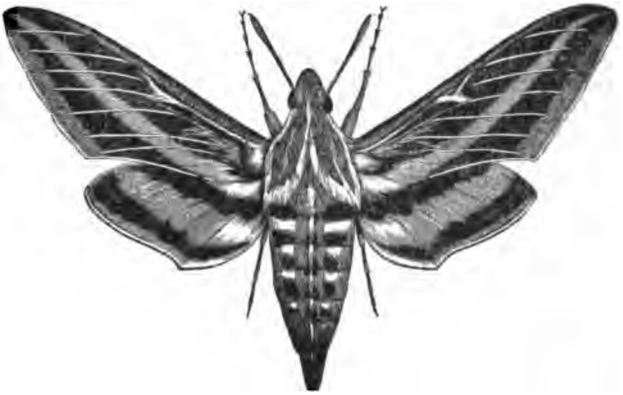


FIG. 65. White-lined Sphinx moth (*Deilephila lineata*). atural size.

The family **Saturniidæ** includes some of the largest and most beautiful of our moths, and the Emperor moth can be taken as a type of this family. The larva forms a cocoon of silk and the insect is sometimes called the wild silkworm. Species of this family are not uncommon in our State, although, being a nocturnal insect, it is not so commonly met with as some of the day-fliers, and when found is sometimes considered as rare by the finder. One of the most striking members of the family which is found here is the *Samia cecropia*. The larva of this moth is a very large caterpillar, and is generally found on the wild shrubbery, although it sometimes attacks fruit trees. Its favorite fruit plant is the Cascara sagrada, or wild coffee, of our foothills.

The family **Ceratocampidæ** comprises moths of large or medium size which do not produce cocoons, but undergo their metamorphosis underground. They are short-bodied and hairy, and usually beautifully colored in tints.

The family **Syntomidæ** is of little interest to us, as its members are more objects of curiosity to the professional entomologist than to the producer, being in no sense of economic importance. They are small to medium sized insects, diurnal in their habits, and frequent flowers. Many of them strongly resemble wasps in their form and markings, and are sometimes mistaken by the uninformed for those insects.

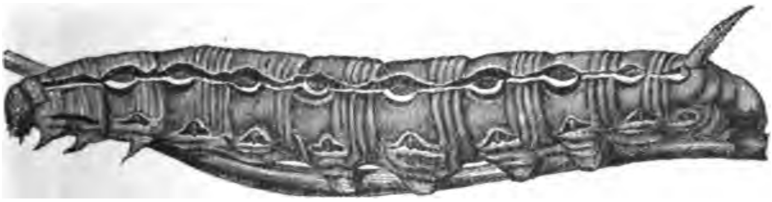


FIG. 66. Caterpillar of white-lined Sphinx moth. Slightly enlarged.

The family **Lithosiidæ** consists of small or medium sized insects, which feed principally upon lichens. They pupate in silken cocoons, in which the hairs of the larva are mixed. They are not, as a rule, destructive to cultivated plants, and so can be dismissed from further consideration here.

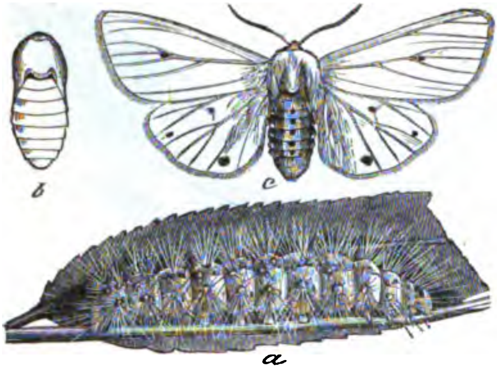


FIG. 67. Yellow bear (*Spilosoma virginica*). *a*, larva; *b*, pupa; *c*, moth.

The family **Arctiidæ** is a very large one, being represented by thirty-eight genera and over two thousand species, of which there are some hundred and twenty species in the United States. It includes the so-called woolly-bears and tiger-moths. They are stout-bodied moths with moderately broad wings and usually spotted or striped. Some of them are very highly colored and others are white. They are mostly nocturnal and are attracted to the light. Their larvæ are covered with long hairs, which grow in bunches, and they are very general feeders, being found on a wide range of vegetables. The Arctiidæ are represented in our State by the fall web-worm, although the family is a very numerous one with us.

The family **Agaristidæ** consists of day-flying moths, usually of moderate size, and it contains some of the most beautiful members of the insect world, although the most beautiful members of it are found in the tropics. In California the wood-nymphs are common, and are representative of this family here.

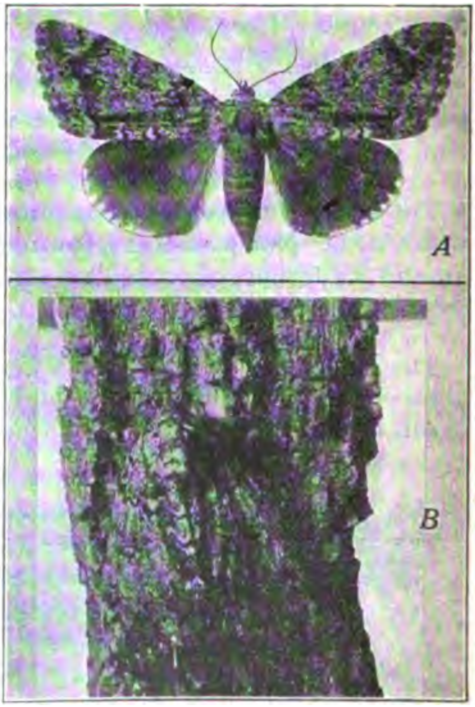


FIG. 68. *Catocala lacrymosa*. A, upper surface; B, with wings closed, and resting on bark. Reduced.

The family **Noctuidæ** includes a very large number of genera and species, there being hundreds of the former and thousands of the latter. The common name is owlet-moths, given them from their nocturnal habits, and their soft-downy appearance. In both respects they resemble owls. In their larval form they are injurious to vegetation, and are among the worst of our insect enemies in this order. The cutworms, which are so destructive to young plants, belong to this family. Many of the moths are dull colored, but, at the same time, the family gives us some of the most beautiful of insects. The catocalas, or underwings, also belong here. The members of this family have very distinct characteristics, by which they may be recognized, and the venation of the wings is especially very constant.

The family **Nycteolidæ** is a small one, resembling the Noctuidæ in many respects, and is represented in the United States by only two genera.

The family **Pericopidæ** somewhat resembles the wood-nymphs, but has a different wing venation. They are not common, and in our State are represented by *Gnophælia vermiculata*, a beautiful moth found in the foothill sections.

The family **Dioptidæ** is represented by only one species, and that a California one, the common live-oak moth (*Phryganidia californica*). This is the light-colored weak moth which appears in such great numbers on the live oaks and sometimes entirely defoliates them.

The family **Notodontidæ** includes a number of families of moths of moderate size, ranging up to two inches spread of wing. They strongly resemble the owlets, from which they differ principally in wing venation.

The **Thyatiridæ** are another family resembling the owlets, but which present sufficient difference to class it as a separate family.

The family **Liparidæ** is of interest to us, as it includes among its members the tussock-moth (*Hemerocampa vetusta*), which is very widely distributed and a very common pest in California. The females of this genus are wingless, or, at least, possess wings of a very rudimentary form. The female deposits her eggs on the cocoon from which she has emerged, and covers them with a frothy mass, after having performed which duty she dies. In spite of the common prejudice against caterpillars, it must be acknowledged that the caterpillar of the tussock-moth is a beautiful insect, with its bright yellow color, the coral red protuberances on the last dorsal segments, and the four creamy brush-like tufts on its back, with the two black plumes on the anterior, and one on the posterior section of the body. Altogether, as a caterpillar, it is remarkable for both form and coloring.

The gypsy-moth (of which we give a beautiful illustration in colored Plate XI), whose work of devastation in the Eastern and New England States has attracted the attention of the whole country, belongs, also, to this family.

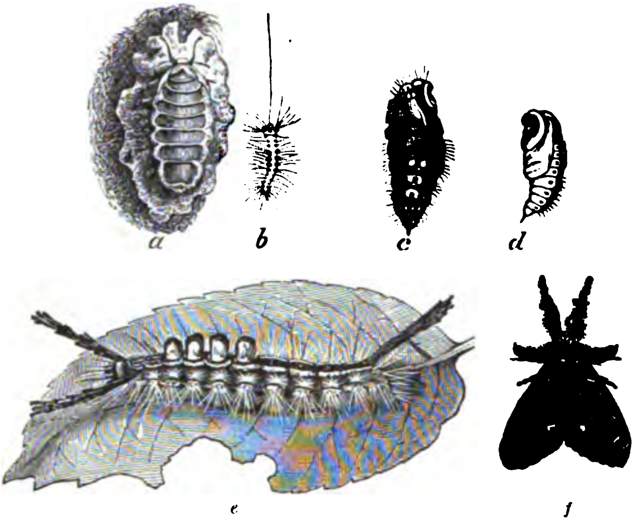
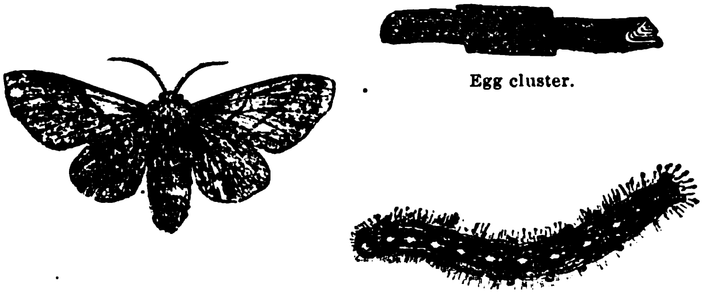


FIG. 69. Tussock-moth (*Hemerocampa vetusta*). *a*, female moth on cocoon; *b*, young caterpillar; *c*, female pupa; *d*, male pupa; *e*, larva on leaf; *f*, male moth.

The family **Lasiocampidæ** is of interest to us principally from the fact that in it we find the tent-caterpillars. The most prominent members of this family are well known from their habit of forming a covering or tent, in which they congregate, returning to it, as to a common home, after they have gorged themselves on the foliage of the trees which they infest. When they outgrow their tent, they form another. The orchard tent-caterpillar (*Clisiocampa americana*) is sometimes a very serious pest in our fruit orchards, especially apples,



Egg cluster.

Female moth.

Larva.

FIG. 70. Tent-caterpillar (*Clisiocampa sylvatica*).

sometimes entangling the whole tree with its webs. They live in communities, feed in droves, and are capable of doing great damage, unless checked.

The family **Bombycidæ** includes the true silkworms. The true silkworm (*Bombyx mori*) appears to be an invention of man in the insect world. Its origin is unknown, none of its species existing in the wild state, and it has been so long under cultivation that it can not live unless cared for by man.

The family **Platypterygidæ** has a few representatives among us, but they are of no economic importance.

The family **Geometridæ** includes those caterpillars commonly known as loopers, inch-worms, measuring-worms, etc. They are all vegetable feeders and very destructive. In it we find the currant span-worm, the spring and fall cankerworms, and many others too well known to our fruit-growers. Over eight hundred species are known to exist in the United States and Canada. The caterpillars lack all save one pair, or in some cases two pairs, of the prolegs found in other caterpillars, and in moving are compelled to make the peculiar motions which give them their popular names. They first extend the body its full length, then bring the posterior end close up to the forelegs, looping the body in the middle, then stretch out the fore part of the body again, and continue these motions until they reach their desired destination. The moths have slender bodies, small heads, and very broad, thin wings. In many species the females are wingless, as in the cankerworms.

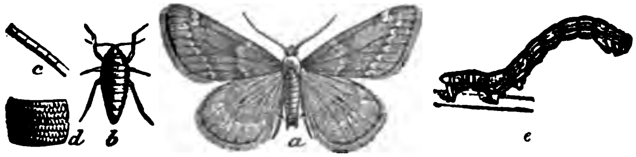


FIG. 71. Fall cankerworm (*Alsophila pometaria*). *a*, male moth; *b*, female moth; *c*, joints of antennæ of female, enlarged; *d*, segment of body of female, enlarged: *e*, larva.

The family **Epiplemidæ** is a small one, closely related to the Geometers, but of little importance to us.

The family **Nolidæ** is another small one of rather small moths, which are of little interest except to the systematic entomologist.

The family **Lacosomidæ** is a small one, and consists of moths peculiar to the western hemisphere. It is thus described by Holland: "While the perfect insects show structural resemblances to the Platypterygidæ, the caterpillars, which have the habit of constructing for themselves portable cases out of leaves, which they drag about with them, resemble in some respects the Psychidæ. The young larva of *Cicinnus melsheimeri*, immediately after hatching, draws together two small leaves with strands of silk, and makes between them its hiding-place. Afterwards, when more mature, it detaches two pieces of leaves, and makes out of them a case which it carries about with it, and which it can desert at will. When at rest it ties the case to a station selected with a few strands of silk, which it bites off when it desires again to start on a journey among the branches. The larva of *Lacosoma* makes a case by doubling a leaf at the midrib, cutting it off at the petiole, and taking it with it as a portable house. There are only two genera of this family in our fauna. It is more abundantly represented in the tropics of South America."

The family **Psychidæ** is of more interest to us, however, as in it we find the bag-worms, or basket-worms, so called from the curious habit the larvæ have of making for themselves a case, or basket, or shelter, composed of pieces of leaves, grass, or fragments of wood or other vegetable substances. These fragments are carefully joined together and lined with silk, spun by the insect. In this case the caterpillar lives securely, and carries it along wherever it goes, much as the snail does its shell. It does not do much damage in our State, as it confines itself to conifers and is not very common. When the bag-worm has attained its full growth, it attaches the bag to a twig and changes to a pupa within it. The male emerges a full-winged insect, but the female is wingless and never leaves the sack, laying the eggs for a new generation within the house she has inhabited during her life.

The family **Cochlidiidæ** consists of slug-like caterpillars, and contains a number of interesting, modest green or brown moths. They are usually of small size and very densely clothed with scales or hair. The larvæ resemble slugs in their general form, being usually oblong in shape and flattened. They have no visible legs and move like slugs. Some of these larvæ have stinging powers, and can inflict a sharp, burning sting when carelessly handled.

The family **Megalopygidæ**, or flannel moths, is a small family of whitish moths, having their wings densely clothed with long, curly hairs resembling bits of flannel. Their larvæ have ten pairs of legs—three pairs of true legs and seven pairs of prolegs—a larger number than in any other family of lepidopterous larvæ. The cocoons have a trap door, through which the moth escapes after it has passed its metamorphosis.

The family **Dalceridæ** is a small one, of no interest to the fruit-grower.

The family **Epipyropidæ** is of interest to us from the fact that it is a family of parasitic moths. Among all the vegetable pests of this order, it is so pleasant to find one that does something toward redeeming its reputation by being of some service in checking pests.

Of the family **Zygænidæ** but few species occur in the United States, and none are destructive to fruit trees.

The family **Chalcosiidæ** is represented by but a single insect, an obscure moth known as *Gingla laterculæ*, found in Arizona.

The family **Thyrididæ** is a small one, and consists of small moths characterized by the presence of small white or yellowish translucent spots on the wings.

The family **Cossidæ** is of more interest to us, for in this we find some of the most destructive of the moth family. To this belong the goat-moths or carpenter-moths, as they are popularly known. In their larval stages they live in the roots and trunks of trees and sometimes do great damage to the tree which they infest. In some cases, in the East, orchard trees have been killed in great numbers by the ravages of these moths. They are said to remain in their larval stage for three years, before they have attained their growth. They pass their transformation in the burrows which they have eaten out in the wood, and when ready for the change the larva forces itself partly out from the burrow. When the moth has emerged, the empty pupa skin can be seen protruding from the burrow. The species most common in California is *Prionoxystus robiiæ*. It is a large gray moth, much resembling the sphinx-moth in general appearance, and flies by night. They are destructive to elms, locusts, and forest trees, but have not as yet been reported as doing damage to fruit trees in our State.

In the family **Ægeriidæ** we have the clear-winged moths—a family utterly unlike any other branch of the Lepidoptera, and many of the members more resembling wasps than moths. They are of small size, with slender bodies, and fly only by day and frequently in the brightest light. They are all borers, and among them are some of our most destructive pests, the Western peach-root borer (*Sanninoidea opalescens*), the Eastern peach-root borer (*S. exitiosa*), the currant borer (*Alcathoe caudatum*), and many others, being representative of the family. Many of the matured insects are very beautiful, and most of them are remarkable on account of their protective mimicry, resembling, as they do, insects of different orders, especially bees, wasps, and flies. This strong resemblance to stinging insects often protects members of this family from danger to which their day-flying habits would otherwise expose them. Yet, in spite of their threats of danger, which are carried out in their acts as well as in their coloring, they are harmless, and it is all a mere bluff on their part to frighten their enemies.

The worst representative of this family which we have in this State is the peach-root borer (*Sanninoidea opalescens*). The following description of the different stages of this insect will aid those who are troubled with this pest in detecting it:

Egg.—The egg is very minute, not exceeding ¼ mm. in length, oval, light brown in color, and, when seen through a lens, ornamented with hexagonal sculpturing. The eggs are deposited on the bark of the tree, at or near the surface of the ground; rarely they are laid high up on the trunk or even in the crotches of the trees. This last phase is generally found in the grafted trees, where gummy exudations have occurred and where grafting has somewhat soured the sap.

Larva.—The young larvæ, on hatching, are very active and immediately burrow into the tree, generally entering the cracks in the bark at or below the surface of the ground. Here they remain constantly feeding on the bark, at first near the surface, surrounding themselves with gum, or coagulated sap, and gradually enter the sapwood, enlarging their burrows as they increase in size. The full-grown larva is pale yellow, about one inch long, tapering with a brown head. After attaining its growth, the borer ascends in the burrow to or above the surface of the ground, as the case may be, and begins to spin a cocoon.

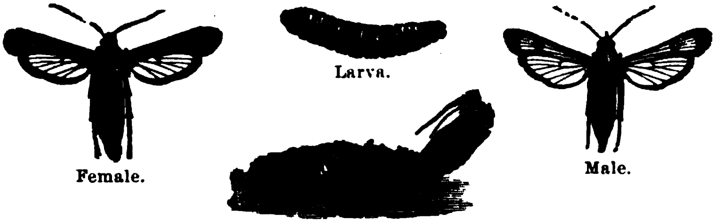


FIG. 72. Peach-root borer (*Sanninoidea opalescens*).

Cocoon.—This is made up of a silken web mixed with castings and earth glued together, and is of a brown color, from 1¼ to 1½ inches long.

Pupa.—The pupa within the cocoon is shiny, light brown, with numerous spines on the abdomen. When about to emerge the pupa is pushed out of the cocoon, and soon the adult moth emerges.

Moth.—To the novice this insect would appear more like a blue wasp than a moth. The female differs so much from the male that they might be taken for two distinct species. The female has bluish-black, opaque front wings, while the hind wings are transparent, like those of a wasp; the margin of both wings has a bluish-black fringe; antennæ, head, thorax, and abdomen are very dark steel blue, almost black; wing expanse, 1½ inches. The male has fore wings nearly transparent, with upper margin and tips black; hind wings are transparent, like those of female; the body is bluish black; the abdomen is much narrower than that of female and more elongated; legs are black, with yellow tufts on femur and tibia; wing expanse, 1¼ inches.

The family **Pyralidæ** includes moths generally of small size, some so small in fact as to be classed as micro-lepidoptera. It has been divided into a great number of subfamilies, genera, and species, so that it would be impossible in a limited space even to mention them all. It contains, however, a number of species injurious to plants, among them the leaf-crumplers, leaf-rollers, case-bearers, and several fruit-worms.

In the family Pyralidæ, and subfamily Galleriinæ, we find that pest of the bee men, the bee-moth (*Galleria mellonella*). This pest is described by Prof. C. V. Riley as follows: "During the daytime these moths remain quietly ensconced in some angle of the hive, but as night approaches they become active, and the female uses her best endeavors to get into the hive, her object being to deposit her eggs in as favorable a place as possible. Wire gauze contrivances are of no avail to keep her out, as she frequently commences flying before all the bees have ceased their work. But even if she were entirely prevented from entering the hive, she could yet deposit her eggs on the outside, or, by means of her extensive ovipositor, thrust them in between the slightest joint or crack, and the young worms hatching from them would readily make their way into the hive. The moment the worm is hatched, it commences spinning a silken tube for its protection, and this tube is enlarged as it increases in size. The worm cuts its channels right through the comb, feeding on the wax, and destroying the young bees on its way. When full-grown, it creeps into a corner of the hive, or under some ledge at the bottom, and forms a tough, white cocoon of silk mingled with its own black excrement. In due time the moth emerges from this cocoon. A worm-infested hive may generally be known by the discouraged aspect which the bees present, and by the bottom board being covered with pieces of bee-bread mixed with the black, gunpowder-like excrement of the worm. * * * If a hive is very badly infested with the worms, it is better to drive out the bees and secure what honey and wax there may be left than to preserve it as a moth breeder to infest the apiary. If put into a new hive, the bees may do something; and if they do not, there is no loss, as they would have perished, finally, from the ravages of the worm."

The family **Pterophoridæ** includes those graceful, elegant little moths commonly known as plume-moths, from the fact that their wings are divided in such a manner as to suggest feathers. Sixty species are known in the United States. They are vegetable feeders, but do little damage to fruit.

The family **Tortricidæ** is so named from its habit of rolling up the leaves of plants upon which the insects feed, and on this account they have received the common name of "leaf-rollers." It must be remembered, however, that not all leaf-rollers belong to this family, nor are all of its members leaf-rollers. The family includes a number of subfamilies, genera, and species. Many of them live in plants or burrow into fruits or the stems of plants, and in this family we find that most destructive of all fruit pests, the codling-moth (*Carpocapsa pomonella*). This one pest causes a loss to the fruit-growers of America running into tens of millions of dollars annually. While the other members of this family are hurtful to plants, none of them, nor all together, have attained the unenviable prominence of the codling-moth.

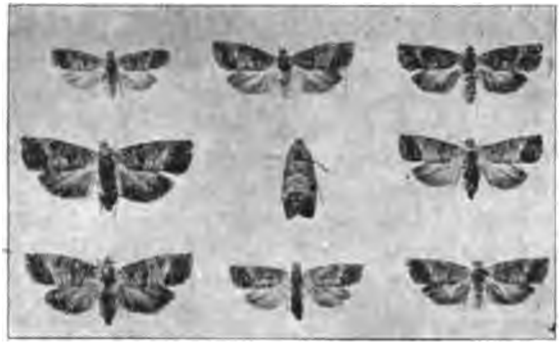


FIG. 73. Codling-moth (*Carpocapsa pomonella*), showing variations. All natural size.

The family **Yponomeutidæ** is of moderate size, containing about sixty species in the United States. It is of little economic value.

The family **Gelechiidæ** consists of small moths, many if not most of them being injurious to vegetation. One of these, an introduced species, by the way, is the potato-moth, which is becoming a very severe pest in this State. In this family, too, is found the destructive peach-twig borer (*Anarsia lineatella*). This pest, like all our worst insects, was probably introduced into California from Japan, of which country it seems to be a native.

The families **Xylorictidæ, Œcophoridæ, Blastobasidæ** and **Elachistidæ** are generally small families of small insects. Their different peculiarities have caused them to be assigned to separate families, but, except to the systematic entomologist, they are of little interest.

In the family **Tineidæ**, however, we have some members which are of direct interest to us. This is a very large family, generally of small moths, although some of them attain moderate size. These insects have narrow wings bordered with a fringe, and some of them, although exceedingly small, are very beautiful. Some of the members of this family are so minute that they attain their full growth and undergo their metamorphosis within the tissue of the leaves in which they live. Some of them, when they appear in great numbers, are very destructive. When it is considered that the leaves of trees are often no thicker than a sheet of paper, and that they consist of an upper and a lower surface, or skin, and that on the fleshy part of the leaves, between these two layers, these insects feed and live and pass through all their changes, it will be understood how minute they, or some of them, are. It is in this family, too, that we find that greatest of all pests to the careful housewife, the clothes-moth (*Tineola bisselliella*). This is not the only culprit, however, for while to the disgusted housewife, who finds her woolens eaten full of holes, there is but one clothes-moth, the entomologist recognizes several species, all guilty of like destruction. Among these are the case-bearing clothes-moth (*T. pellionella*), the tube-building clothes-moth (*T. tapetzella*), and the naked clothes-moth (*T. bissellie1la*), mentioned above.

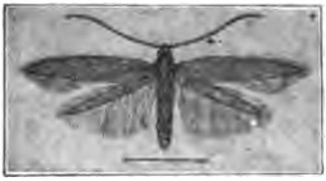


FIG. 74. Cigar case-bearer (*Coleophora fletcherelli*).

The family **Hepialidæ** is a small one, composed of large or moderate sized moths. Its members are not sufficiently numerous to be of importance economically.

The **Micropterygidæ.** The last family of this branch of the order Lepidoptera is one of little importance to our readers. This family is remarkable only for the reason that it reveals certain anatomical features which are thought to point out an early connection between this and other orders.

Order **DIPTERA.**

(Two-winged Flies.)

Like that of the other orders of insects, the name of this order is composed of two Greek words, *dis*, two, and *pteron*, wing. As before stated, the wing peculiarities have been taken by entomologists to divide the orders of insects, and in this order most of the members have but two wings, while in all others, as a rule, there are four wings present. But even to this rule there are exceptions, as we have shown, for in most of the orders some of the members are wingless, while in some, as in the male of scale insects, there are two-winged insects. But the rule works in the Diptera to this extent, that most of its members have two wings and no more. There is in them what appears to be the rudiments of another pair, in a pair of little knobbed hooks, known as halteres, which occupy the place of hinder wings in the members of other orders. These halteres are present even in those few species in which the fore wings are entirely absent.

As with the word "bug," so with the word "fly"; it is wrongly used. To the average person, either of these terms may mean almost any kind of an insect, the latter, of course, being applied to insects with wings which are not butterflies or moths. The name "fly," however, is only properly applied to members of the order Diptera.

Considering the number of individuals and the number of species, flies very greatly exceed any other order. They are common everywhere, in the houses, fields, swamps, and plains. Their members swarm in every place ever penetrated by man. Within this order are some of the most serious pests with which we are troubled, and they attack alike our animal and vegetable products, and man himself suffers more from them than from any other of the orders. We can escape in some manner our insect enemies in the other orders, but not always the Dipterons.

In this order we have the mosquito family, some members of which spread disease and death in the germs of yellow fever and malaria. It may be safely asserted that this family alone is the source of greater suffering, hardship, and even death to mankind than any other one cause. This order, too, furnishes the dreaded fruit-flies, one of the most destructive pests with which the fruit-grower has to cope, and which fortunately has not yet obtained a foothold in California. The disreputable botfly; the sheep-tick, a wingless form; the Hessian-fly, which causes a loss to the farmers of the United States of $100,000,000 annually; the ox warble fly, which causes a loss as high as $40,000,000 on hides, and others too numerous to mention, but most injurious to a greater or less extent, all belong to this order of two-winged flies. At the same time, there are many of its members which are friendly to man and which give us some of our most valuable beneficial insects. Among these are the Tachnid flies, one of which is the principal check on the locusts, and without whose work California would suffer severely every season from the locust pest. The Syrphus flies are another of our friendly families which feed upon the aphids and serve largely to keep them down.

As indicating the vast numbers of this order, it may be stated that there are already over 40,000 described species, and it is estimated that this number would be increased to 350,000 if all the species were known.

All the members of this order are suctorial insects, and their mouth parts are formed to this end. The methods of different species in procuring their food, however, differ widely. Some simply absorb fluids, or reduce their food to a fluid state, in order to absorb it, as with the house-fly; others are provided with a piercing beak, with which they are enabled to drill a hole into their victim and suck his blood, as with the mosquito. Some absorb the juices of vegetables, others of animals, and others again have no choice but to take whatever comes handiest.

The larvæ of flies are known as maggots. They are usually footless grubs, and pass through a perfect transformation. In some cases the eggs hatch within the body of the female, and the young maggots are produced alive, and, in other cases even, the female gives birth to the young in the pupa form. As a rule, however, there are the usual well-defined periods of the insect life. With many of the flies, as in the case of meat-flies, the eggs hatch very soon after deposition, and the insect passes through all its changes in a very short time. In this we see a wise provision of nature, which arranges that the fly shall pass through its young stage and reach perfection while its food is available. If it were to remain long in its larval stage, its food supply would putrefy, and dry up before the insect matured, and the young fly would die of starvation.

Flies are adapted to various conditions, and breed under all circumstances. Some are aquatic, as the mosquitoes; some subterranean, as the crane-flies. Many breed in dirt and filth, and some swarm in cesspools, as the rat-tailed larvæ—the young of a Syrphus fly—and we have seen masses of maggots crawling in the crude oil running from the wells, and apparently well satisfied with conditions which would have knocked out any other form of insect life.

One of the most terrible of the dipterous pests is the so-called screw-worm (*Compsomyia macellaria*). This is a common species throughout a large portion of our country, and ordinarily feeds upon dead or decaying vegetable matter. Under some circumstances, however, it attacks living animals, and in the Southern and Southwestern states occasionally becomes a terrible pest. On such occasions it lays its eggs on man or animals wherever there is the slightest trace of a wound, bruise, or offensive discharge of any kind. The larvæ bore directly into the living flesh, causing intense pain as well as suppurating sores. Living larvæ are produced, as well as eggs almost ready to hatch, and in any opening from which there is a discharge of any kind eggs may be deposited. Sleeping humans with an offensive breath, or with a fetid discharge from the nostrils or mouth, have had eggs laid at these points, and larvæ have made their way into the head in some cases, causing the death of the individual. Eggs have also been laid in the ears of uncleanly people, and the channels and passages of these organs have been penetrated into the head and destroyed. Animals are troubled in the same way, and where the insects are abundant their attacks often become fatal. The following, which appeared in a San Bernardino paper several years ago, gives a very vivid account of the work of this dreaded insect: "George Madden, a Western Union Telegraph lineman, was brought to the county hospital from the desert afflicted with a most loathsome complaint, actually being eaten up alive by thousands of minute worms which have hatched from the eggs laid in his nostrils while he was asleep. A description of his condition is too revolting to be printable. Madden states that three weeks ago he was employed by the telegraph company at Los Angeles and was sent to the Arizona desert. At night he was considerably pestered by gnats, but had no idea of the terrible danger to which he had been exposed until a week later, when he was seized with dizziness. He was taken to Needles, where it was discovered that the gnats had deposited eggs in his nostrils and that they were hatching. The poor fellow was brought here, where everything possible is being done to allay his sufferings, but no hope is entertained for his recovery. This is the second case of the kind treated here."

The Diptera are divided into two suborders, the Orthorrhapha, in which the insects make their escape from the pupa case either through a T-shaped slit near the head, or in fewer species through a crosswise slit between the seventh and eighth abdominal segments. The second suborder is the Cyclorrhapha, in which the insect, after passing its metamorphosis, escapes from the pupa case through an opening made at the head part of it. These two suborders are divided into families, according to Comstock's classification, which we have adopted, as follows:

Suborder **ORTHORRHAPHA.**

1. Psychodidæ, the Moth-like flies.
2. Tipulidæ, the Crane-flies.
3. Blepharoceridæ, the Net-winged Midges.
4. Dixidæ, the Dixa-midges.
5. Culicidæ, the Mosquitoes.
6. Chironomidæ, the Midges.
7. Mycetophilidæ, the Fungus-gnats.
8. Cecidomyiidæ, the Gall-gnats.
9. Rhyphidæ, the False Crane-flies.
10. Orphnephilidæ, the Solitary-midge.
11. Bibionidæ, the March-flies.
12. Simuliidæ, the Black-flies.
13. Tabanidæ, the Horse-flies.
14. Stratiomyiidæ, the Soldier-flies.
15. Leptidæ, the Snipe-flies (in part).
16. Acroceridæ, the Small-headed flies.
17. Nemistrinidæ, the Tangle-veined flies.
18. Asilidæ, the Robber-flies.
19. Midaidæ, the Midas-flies.
20. Apioceridæ, the Apiocerids.
21. Bombylidæ, the Bee-flies.
22. Therevidæ, the Stiletto-flies.
23. Scenopinidæ, the Window-flies.
24. Empididæ, the Dance-flies.
25. Dolichopodidæ, the Long-legged flies.
26. Lonchopteridæ, the Spear-winged flies.

Few of the families of this suborder are of interest to us from an economic viewpoint, as most of those mentioned have no direct bearing upon our welfare; they may, therefore, be dismissed with a bare mention. Some, however, are of more importance, as among them we find some of our most beneficial insects, our friends, as well as some that are very destructive, or, at least, very injurious to us.

The family **Psychodidæ** consists of small flies very much resembling moths in appearance, and are often found on the under side of leaves.

The family **Tipulidæ** includes the crane-flies, sometimes popularly called daddy-long-legs. The larvæ of these flies live in the ground and are very tough and wiry, resembling wireworms in this respect. They live on grass and grain roots and may become very destructive. Sometimes they are so numerous as to kill out lawns in which they have become established. There are a large number of species, ranging in size from a gigantic insect, an inch and a half in length, with a spread of leg several inches in diameter, to some not larger than mosquitoes, which they greatly resemble in general structure. This family is representative, so far as the structure is concerned, of a large group, the *Midges*, which resemble them. In these the bodies are long and tapering, the legs generally very long and usually widely spread, so that the insect has the appearance of walking on stilts.

The family **Blepharoceridæ**, the net-winged midges, includes several families of aquatic insects, somewhat resembling mosquitoes in form, but different from them in wing venation. They breed in swiftly running water, and in some species there are two forms of females, one of which is blood-sucking, while the other lives by sipping nectar.

The family **Dixidæ** is another family of midges also resembling mosquitoes, and differing from the former family in wing venation.

The family **Culicidæ** is one altogether too well known, as it is in this that we find the whole abominable race of mosquitoes. This is not a very large family, although it is perhaps one of the worst enemies with which the animal world, including man himself, has to contend. Members of this family are found the world over. In some sections of the tropics they are so bad as to render the places infested by them uninhabitable, and miners

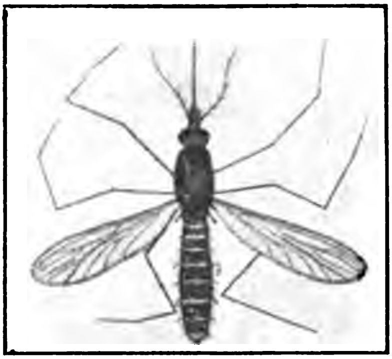


FIG. 75. Adult female of *Culex pipiens*, enlarged. (Miss. Agr. Exp. Station.)

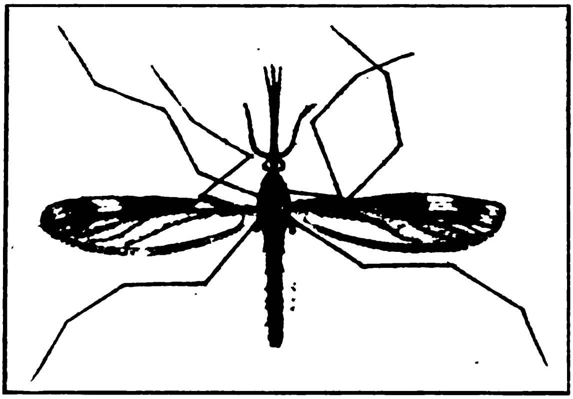


FIG. 76. Female of *Anopheles punctipennis*, enlarged. (Miss. Agr. Exp. Station.)

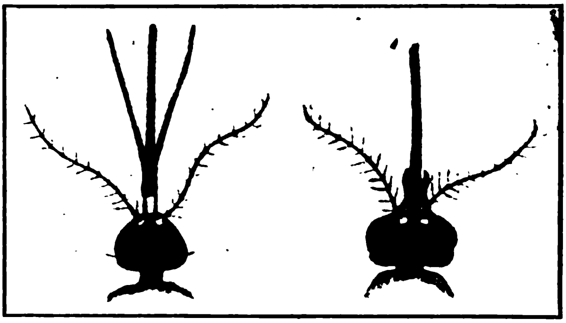


FIG. 77. At left, head of male *Culex*; at right, head of female *Culex*, enlarged. (Miss. Agr. Exp. Station.)

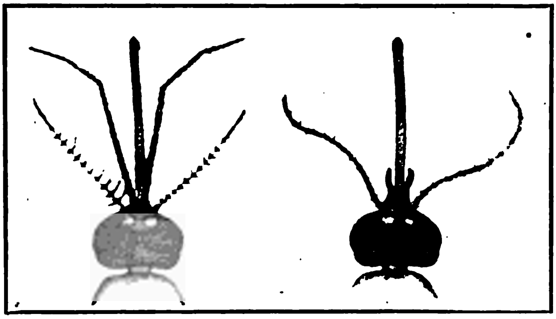


FIG. 78. At left, head of *Anopheles*, showing appendages: at right, head of *Culex*, showing appendages. Enlarged. (Miss. Agr. Exp. Station.)

in far northern Alaska report them as the severest plague of that section. Explorers have not yet penetrated sufficiently far to the north or south to escape the .mosquito. Every one dreads this pest. Their droning sound in the still hours of the night always brings with it a feeling of irritation and dread, and the poisonous wounds inflicted by them are well known to everybody. It has now been definitely proven that the bite of the common mosquito, *Culex irritans*, with all its pain and irritation, is the lesser evil inflicted by the members of this family, for there is now no doubt that they are active agents in the spread of malaria and yellow fever, and perhaps of other malignant contagious diseases. To the non-entomologist a mosquito is a mosquito, but to the entomologist there are numerous species included under this title, all of varying degrees of badness, ranging from bad to worse and worst, the plagued *pipens*, which annoy us so, not being among the worst. The malaria-spreading mosquito is known as *Anopheles maculipennis*, while that to which we owe the dissemination of yellow fever goes by the name of *Stegomyia fasciata*. It would seem that the blood-sucking propensity of the mosquito family is an acquired taste, for while all that can, absorb our blood with that of other warm-blooded animals, they breed in countless billions in swamps and marshes, far from any warm-blooded animals, and there they live and die without tasting blood.

The mosquito breeds in water, and the so-called wigglers found in stagnant pools are the young form or larvæ. While aquatic in their mode of life, these larvæ are air-breathing, and have to come to the surface for a supply of air. For this reason they frequently come to the top, stick out their breathing apparatus, which is a sort of tail-like tuft, and after absorbing the supply of air, disappear in the depths of their breeding-pool again. It is for the reason that the larvæ are compelled to come to the surface to breathe that pouring coal oil over stagnant pools will keep them down and is the most effective remedy for this evil.

The family **Chironomidæ** are the true midges, small mosquito-like insects. They differ from the former family in their wing markings and habits, not being addicted to blood sucking. Sometimes they are so numerous as to be annoying, but otherwise they are neither good nor bad.

The family **Mycetophilidæ** consists of small to medium insects, generally resembling the mosquito in structure. The larvæ live upon fungi and decaying vegetable matter.

The family **Cecidomyiidæ**, the gall-gnats, are small insects, including the smallest of this order. Their common name indicates their habits. Many of them are very serious pests to the farmer, for in this family are many which attack crops, as the clover-leaf midge and the wheat midge, both of which do great damage to crops, and here we have that worst of all grain pests, the Hessian-fly. It is impossible to accurately estimate the amount of damage actually inflicted upon our farmers annually by this pest, but it runs into the hundreds of millions. Fortunately the wheat-growers of California have not been troubled much by this insect, due, probably, to the habit of burning over old stubble in the fields, by which means the eggs are destroyed.

The **Rhyphidæ**, the false crane-flies; the **Orphnephilidæ**, the solitary-midges; the **Bibionidæ**, the March-flies; and the **Simuliidæ**, the black-flies, are all families of little importance except to the entomologist.

The family **Tabanidæ** includes the horse-flies. These are well known and are one of the worst pests of our domestic animals during the summer season, when they sometimes attack horses in swarms and cause them much trouble. These insects have such sharp mandibles that they can pierce the skin as soon as they alight, and man himself often suffers from their attacks. In their larval, as well as in their mature, form, these insects are carnivorous.

The family **Stratiomyiidæ**, or soldier-flies, is so named from the bright-colored stripes borne by some members. These flies are common in the vicinity of swamps, and are both carnivorous and vegetarian.

The family **Leptidæ** embraces the snipe-flies, so called from the fancied resemblance to those birds, due to a lengthened abdomen. The members of this family are predaceous, and frequent low shrubbery and grass. The larvæ live in the earth, decaying wood, and sometimes in water, and in this form they are always predaceous.

The family **Acroceridæ** are the small-headed flies, peculiar-looking insects, in which the head is disproportionately small in comparison with their bodies.

The family **Nemistrinidæ** are medium-sized insects, some of them resembling horse-flies.

The family **Asilidæ** includes the robber-flies, of which there are so many species, and all are predaceous, preying upon other insects. They live largely upon moths, and in their larval form prey upon the larvæ of beetles. They are not at all discriminating in their choice of food, however, and attack many insects. They are mostly large flies, some species being an inch or more in length. Usually they are long, with a sharp, tapering abdomen, although some species are short and stout and somewhat resemble a bumblebee in form. From their predaceous habits and their voracious appetites, they may be classed as beneficial insects.

The **Midaidæ**, the midas-flies, which resemble the robber-flies somewhat in appearance; the **Bombyliidæ**, the bee-flies, in which family there are many which strongly resemble bees in color and markings; the **Therevidæ**, or stiletto-flies, are all families of little importance except to the professional entomologist.

The **Scenopinidæ**, or window-flies, are so called from their habit of congregating in the windows. They are small insects with a long, slender body, much sharper than the common house-fly, and in the larval form are sometimes found under carpets and in decaying wood.

The last family in this suborder is the **Lonchopteridæ**, or spear-winged flies, and one of little interest to us.

Suborder CYCLORRHAPHA.

The second suborder into which the Diptera are divided is the *Cyclorrhapha,* which includes all those flies which make their escape from the pupa case, or larval skin, by a round opening formed in the top by the imago pushing out its head, the first suborder which we have been considering escaping through a slit made in the back.

1. Syrphidæ, the Syrphus-flies.
2. Pipunculidæ, the Big-eyed flies.
3. Platypezidæ, the Flat-footed flies.
4. Phoridæ, the Humpbacked flies.
5. Conopidæ, the Thick-head flies.
6. Œstridæ, the Botflies.
7. Muscidæ, the Muscids.
8. Hippoboscidæ, the Louse-flies.
9. Nycteribiidæ, the Bat-ticks.
10. Braulidæ, the Bee-louse.

The family first to be considered here is the **Syrphidæ,** in which we find several beneficial species. This is a very large family and includes over 700 species so far named and described. They are moderate-sized insects and are great mimics, many of them strongly resembling bees, wasps, and other insects. In fact, the *Eristalis tenax,* or drone-fly, so strongly resembles the honey-bee that it is frequently mistaken for it, the principal difference being in the fact that it is a dipterous insect, while the bee has four wings. Another difference is that this insect has no sting, although its strong resemblance to the honey-bee admonishes the ignorant to avoid it. The larva of this fly lives in cesspools and decomposing filth of any kind. It is provided with a long breathing tube, which is a continuation of the abdomen, and it is commonly known from this appendage as the "Rat-tailed larva."

A common member of this family is a black and yellow banded insect, much resembling a yellowjacket, which may be seen hovering motionless in the air over flowers on a summer day, making a sudden dart occasionally in one or another direction. The larva of this is predaceous on aphids, and is one of the many beneficial insects to which we owe so much.

The larvæ of the different species of Syrphus-flies have various feeding habits; some, as stated above, are predaceous on aphids; some feed on decaying animal and vegetable matter; some are found in the nests of ants, and others in the nests of bumblebees and wasps.

The **Pipunculidæ,** or big-eyed flies, are remarkable mainly for the disproportionate size of their eyes, which seem to swell the head beyond the size of the body. They frequent plants and are parasitic on bugs.

The **Phoridæ**, or humpbacked flies, is a family of small insects, the larvæ of which are parasitic.

The **Conopidæ** is a family of large-headed flies, any of which in their mature form resemble wasps in general appearance, having the abdomen elongated and connected with the thorax by a slender pedicel. They are common among flowers, and their larvæ are parasitic on bumblebees and wasps.

The family **Œstridæ** consists of the botflies. The members of this family are medium to large in size, of heavy build, resembling bees in general structure, and the family contains some of the worst pests which our four-footed animals have to struggle against. In this family is found the botfly of the horse, the warble of the ox, the sheep gadfly, and their kindred, which, in their larval stage, live upon the intestines or muscles of quadrupeds.

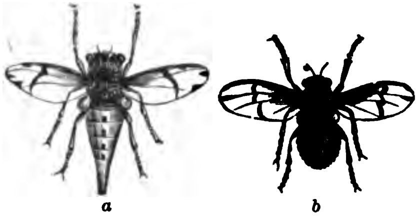


FIG. 79. Horse botfly (*Œstrus equi*). *a*, female; *b*, male. Both enlarged.

The reproduction of these insects is one of the freaks of nature, and is accomplished in the most roundabout manner. The female of the horse botfly lays her eggs on the legs or other handy portions of the horse, and so well does the animal know his enemy that horses will run in terror from them. The eggs are small yellowish bodies, furnished with hooks, by which they are attached to the hairs of the horse, usually the lower portion of the legs. It is wonderful, too, with what rapidity a fly will attach her eggs to the selected spot. We have watched them in action, and seen them dart at the spot and away again, not even resting, but in the short contact an egg was securely placed. The eggs are taken into the mouth of the horse, which licks itself, and the moisture and warmth cause them to hatch at once. The irritation occasioned by them causes the animal to swallow them and then they attach themselves to the coating of the stomach, where they remain until they have attained their larval growth, which requires eight or ten months. They are then passed, and fall to the ground, going through their pupa stage underground.

The ox warble is also taken into the stomach of the animal, but works its way between the muscles until it reaches the back, where, just beneath the skin, it grows rapidly until it has reached its full larval growth, when it enlarges an air hole, which it had already made in the skin, and passes out, dropping to the ground and going through its transformation underground.

The family **Muscidæ** is the largest of the whole order, including about one third of all the species of Diptera known. The common house-fly belongs to this family. Comstock separates this family into two divisions, the *Calyptrate Muscidæ* and the *Acalyptrate Muscidæ*, and under each of these divisions there are several subfamilies.

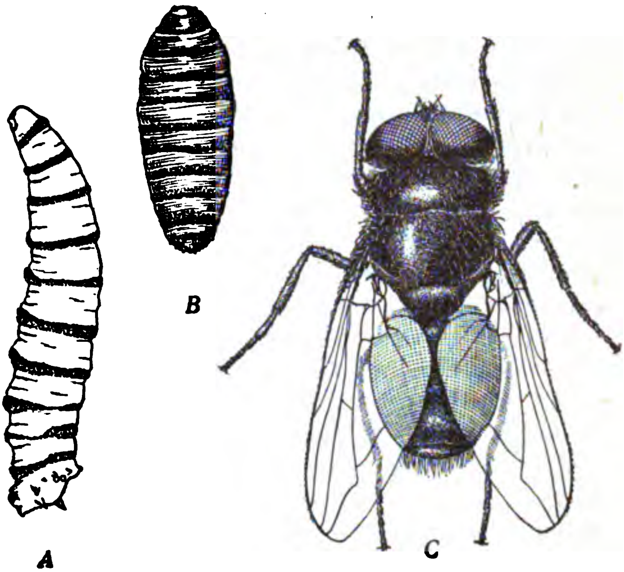


FIG. 80. *Formia regina.* A, larva; B, puparium; C, imago.

The subfamily **Tachininæ** is one of the most beneficial of the order Diptera. The subfamily includes a number of species, several of which are found in California. In their larval form they are parasitic, and

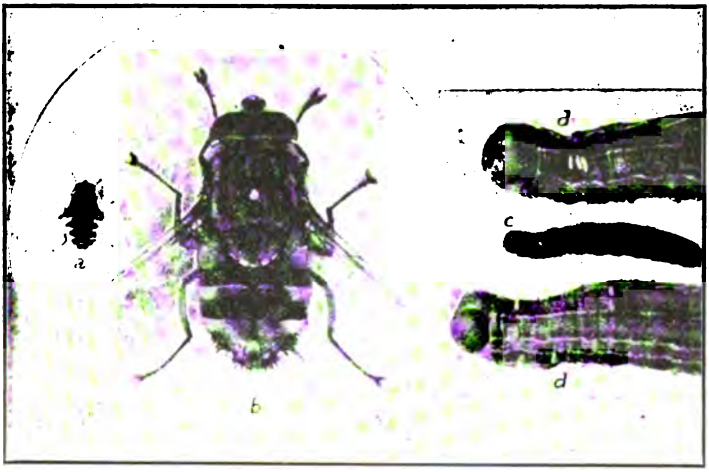


FIG. 81. Red-tailed tachina fly (*Winthemia 4-pustulata*), a parasite of the army-worm. *a*, fly, natural size; *b*, fly, enlarged; *c*, armyworm, natural size, upon which eggs have been laid; *d*, parasitized armyworms, enlarged. (After Slingerland.)

lay their eggs upon the larvæ of other insects, largely on caterpillars, upon which the female fly lays her eggs. These eggs soon hatch out small footless grubs, or maggots, which at once proceed to bore their way into the body of their host, where they remain until they have attained their growth. We have often been disappointed when, after caring for a choice specimen of caterpillar, until it passed into the chrysalis state, and were watching anxiously for it to come out, to have a small handful of Tachnid flies reward us for our pains.

In California one species of Tachininæ is a most effective check upon the locust pest. This is the *Masicera pachytyli* Sk., and where there is a flight of grasshoppers these flies will be found in countless numbers, and the grasshopper which escapes them is rare. It is the natural enemy of the grasshopper, feeding most voraciously on the adipose tissues of its victim, but avoiding the vital parts. It feeds in the thorax and abdomen, and frequently three or four may be found in a single grasshopper. A grasshopper infested by these maggots soon shows signs of feebleness, ceases feeding, and dies in a short time, the maggots escaping often before the death of the host insect. The maggots, after extricating themselves from the grasshopper, enter the ground to pupate, and emerge in five or six days as perfect flies.

There is no more effective check upon cutworms and other lepidopterous pests than the Tachina flies.

The subfamilies **Sarcophaginæ**, the flesh-flies, and **Dexiinæ**, the nimble-flies, are of less importance to us.

The subfamily **Muscinæ**, however, embracing the house-flies, and other species equally obnoxious, forces itself more upon our consideration. The house-fly (*Musca domestica*) is known by every one the world over. It is a highly sociable insect, and clings to mankind with a tenacity more to be repudiated than admired. Its breeding places are around stables, and a female will lay from 120 to 160 eggs. The larvæ attain their growth in from five to seven days, pass through their changes in another five to seven, and then make a line for our houses. Keep-

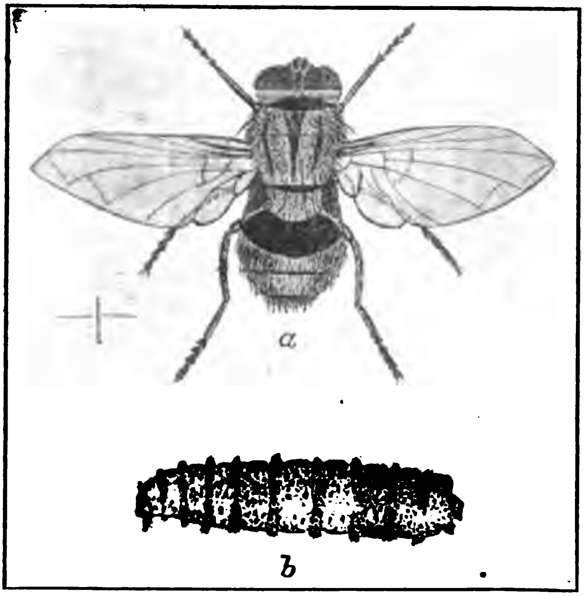


FIG. 82. Screw-worm fly (*Compsomyia macellaria*), enlarged. a, adult fly; b, larva. (After Francis.)

ing the stables clean, and removing all rubbish from around the house will do much to prevent them.

The stable-fly (*Stomoxys calcitrans*) resembles the house-fly, but its mouth parts are made for biting, while the house-fly is a sucker. Severe bites, and sometimes poisonous ones, are inflicted by this insect, for which the house-fly gets the blame.

The horn-fly (*Hæmatobia serrata*) is another dipterous pest of cattle.

The screw-worm (*Compsomyia macellaria*), to which we have before alluded, belongs also in this subfamily; as does the blowfly (*Caliphora vomitoria*), the largest of the common species, with a deep blue, almost black body, always coming in swarms when there is an odor of cooking cabbage or decomposing meat.

The subfamily **Anthomyiinæ** is a very large one, including the cabbage-maggot, onion-fly, and many others which infest vegetation. Some of its members are parasitic on other insects, and others infest decaying vegetation. Some of these resemble house-flies, but differ from them in structure.

The second division of the Muscidæ is the **Acalyptrate Muscidæ**, and this includes the fruit-flies, the dreaded *Trypeta ludens* among others. Most of the flies belonging to the subfamily **Trypetinæ** are small, although some of them are at least medium in size. They are characterized by their peculiar wing markings, which are shaded, mottled, banded, or striped. They vary in color from light brown to nearly black, and the family is well represented in the United States. It must not be supposed that because *T. ludens*, *T. pomonella*, and several others of our fruit pests belong to this family, all are pests on fruit. It is true that most of the fruit-flies belong here, but a very large number of the species live in galls which they form in the stems of wild plants, and are not noticeably injurious.

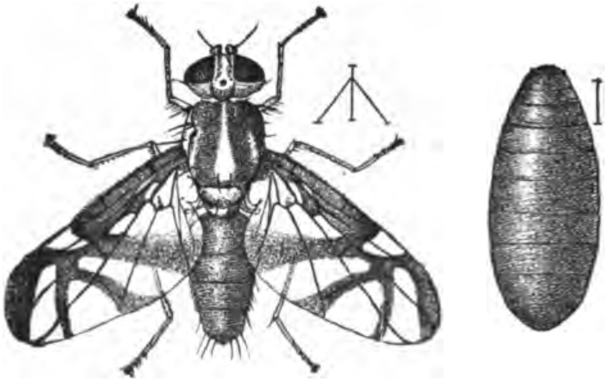


FIG. 83. *Trypeta acidusa.* Puparium at right, adult at left, greatly enlarged. (After Howard.)

The cheese-maggot (*Piophila casei*) belongs in this group, as do also the vinegar or pomace flies—small, yellowish flies, common about decaying fruit.

The family **Hippoboscidæ** includes the louse-flies. Some of these are winged and some wingless. They are parasitic upon birds and mammals. The best known member of this family is the sheep-tick, a wingless species, which lives upon sheep.

The family **Nycteribiidæ,** or bat-ticks, are, as their name implies, parasitic on bats. They, too, are a wingless species.

The family **Braulidæ** includes the bee-louse, a minute wingless creature, infesting the honey-bee.

Order SIPHONAPTERA.

This is an order erected to take in the fleas. These insects have many peculiarities in common with flies, and at one time were considered as degraded Dipterons. The order contains but a single family, **Pulicidæ.** There are a number of species, however, afflicting various animals. The dog and cat have their special fleas, and man another, the latter being the *Pulex irritans*, a description of which is not necessary for California readers.

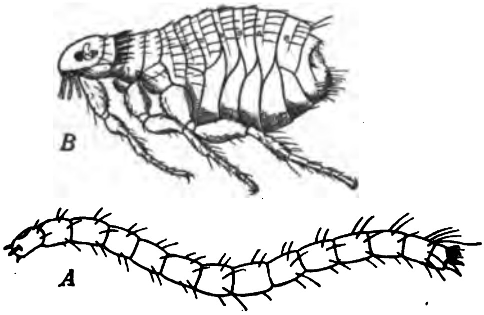


FIG. 84. Cat and dog flea (*Ctenocephalus canis*). A, larva (after Kunckel d'Herculais); B, adult. Length of adult, 2 mm.

The *Chigoe*, a small species, common in warm climates, is sometimes a very serious pest. The female has a habit of burrowing into the flesh, between the toes of the natives, or others, when opportunity allows. In this position, with her abdominal end protruding, she swells with eggs to the size of a pea, when the eggs are obtruded and shed on the ground. Unless removed, these pests sometimes cause great suffering.

Order COLEOPTERA.

(The Beetles.)

The Coleoptera, or beetles, are, perhaps, not so familiar to the general observer as the butterflies and moths, although they outnumber them in species two to one, for they are generally obscure in their habits in both larval and adult stages, and when seen are usually avoided on account of their unfriendly, or, in some cases, disagreeable aspect. But they are so numerous, over 12,000 species being known, and so easily collected and preserved, that the amateur collector of insects is attracted to them nearly as much as to the Lepidoptera.

Beetles are characterized by the possession of a pair of horny wing-covers, called elytra, which meet in a straight line down the back, and beneath which is a single pair of membranous wings. They possess biting mouth parts, and the metamorphosis is complete. The earwigs are the only insects that might be mistaken for beetles, but as they possess a pair of pincers-like appendages at the end of the body, they may be readily distinguished from them.

The name Coleoptera is derived from the Greek *coleos*, a sheath, and *pteron*, a wing. The name refers to the sheath-like structure of the elytra, which were formerly believed to be modified wings, but which are now known to be homologous to the plates, or paraptera, which exist at the bases of the wings of the lower orders of insects. The true wings are membranous, and are efficient organs of flight in most species. When at rest they are folded beneath the elytra. In those species which have no true wings, the elytra serve only as a protection to the soft abdomen. The mouth parts are evenly proportioned, no part being over-developed at the expense of others, as in the Lepidoptera or Hymenoptera. The upper lip, or labrum, is usually distinct; the upper pair of jaws, or mandibles, are strong and fitted for seizing or gnawing; the lower jaws, or maxillæ, are composed of several distinct pieces, and bear prominent palpi; the lower lip, or labium, is also complicated in structure, and bears prominent palpi. The antennæ of beetles are extremely varied in form, being serrate, clavate, moniliform, or irregular, as the case may be. The tarsi, or feet, have from three to five joints, the last joint usually terminating in a pair of claws.

Since Coleoptera possess no easy means of identification, entomologists have had to separate groups and species by means of obscure specific differences in the structure of organs and parts of the body. The antennæ, mouth parts, and sclerites or plates of the body are usually employed, but such a mass of technical terminology has, of necessity, piled up on this account that the ordinary student of Coleoptera is much mystified.

The eggs of beetles are laid where the larvæ, upon hatching, will find an abundance of food suited to their needs. It may be on leaves, twigs, decaying logs, carrion, fresh water, or underground. The larvæ are known as grubs, wireworms, water-tigers, and the like. They usually possess six thoracic legs (some species have more), biting mouth parts, and simple eyes. The larval life lasts from a few weeks in some species to three years in others. After several molts they change into pupæ, either underground or in or on the food, using the last larval skin as a pupa case, or constructing a rough cocoon of earth and bits of wood and vegetable matter.

Only such of the eighty families as possess especial interest or economic importance can be treated, even briefly, in a short discussion.

The order is divided into two primary groups or suborders, *Coleoptera genuina* and *Rhyncophora*. *Coleoptera genuina* includes the typical beetles, with the mouth parts all present, and the head not elongated into a beak or rostrum. In the *Rhyncophora*, or snout beetles, the head is elongated, the labrum is indistinct, and the palpi are reduced to small processes. These two suborders are further divided into sections, tribes, families, genera, and species.

Suborder **COLEOPTERA GENUINA**. Section **PENTAMERA**.

The beetles in the section Pentamera all have five tarsal segments in all the feet. The **Adephaga**, one of the four tribes in this section, are the carnivorous beetles, and embrace four important families.

The members of the family **Cicindelidæ** are characterized by their metallic colors with light markings on the wing-covers, their graceful forms, rapidity of movement, and alert habits. They are commonly seen running and flying swiftly about sandy, sunny places. Both larvæ and adults are noted for their rapacity and ferocity, and these traits, combined with the curious markings on the elytra, have given them the name of tiger-beetles. The larvæ of tiger-beetles are repulsive in appearance, possessing large heads, which are bent at right angles downwards from the body and furnished with immense jaws and sprawling legs. They live in the sand in vertical burrows several inches deep, and in these they lie in wait ready to grasp any unwary insect that comes within their reach. To keep themselves from being pulled out by a larger insect than themselves, they possess two strong small hooks on the back of the fifth body segment. The pupal stage is passed in the burrow, also in the last larval skin. The tiger-beetles, especially the larvæ, are beneficial to the fruit-grower, as they devour quantities of injurious caterpillars.

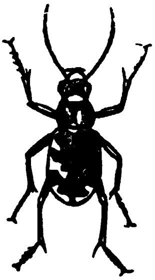


FIG. 85. Tiger-beetle (*Cicindela rapan*).

The **Carabidæ** are a family of flat, smooth beetles, usually shining black, greenish or brownish in color, with small heads, prominent slender antennæ, sharp mandibles, clubbed antennæ and conspicuous eyes. They are active and swift runners, ready to bite when caught. Most of them hide by day under boards, stones and the like, seldom taking to flight, and hunting their prey at night. The larvæ of many species live in the ground, where they destroy quantities of burrowing insects. The pupal stage is passed in rough cells in the earth, the emerging adults pushing their way to the surface.

The "searcher" or "caterpillar hunter," *Calasoma scrutator*, is one of the most familiar and beneficial of the Carabids. It is especially destructive to tent-caterpillars, climbing the trees at night and feeding on them. Other species are predaceous on cankerworms and cutworms.

The bombardier-beetles (genus *Bruchina*) possess an organ at the tip of the abdomen by which when disturbed they spurt out, "with a popping sound and puff of smoke," an ill-smelling, acrid fluid. *Harpalus* is a large genus, any species of which destroys large numbers of the larvæ of the codling-moth and plum-curculios.

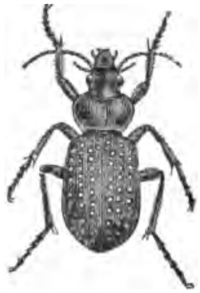


FIG. 86. *Calasoma* sp.

The **Dytiscidæ** are a family of carnivorous water-beetles of some three hundred species, common in all our streams and ponds, many of them from one to two inches long and quite conspicuous. They possess a single pair of eyes, long, slender antennæ, are flatly convex in shape and brown or black in color; the swimming hind legs are long, broad, and heavily fringed with hairs, and their air supply under water is carried in a bubble under the elytra, held in by means of fine hairs. The larvæ are long and slender, and on account of their voracity are called water-tigers. They breathe through a pair of spiracles at the top of the body, coming to the surface frequently for the purpose. The pupal stage is passed in a rough cocoon in the bank of the stream or pond.

The **Gyrinidæ,** or whirligigs, are the small, metallic, steely black beetles seen swimming in circles on the surface of ponds and still pools. They are peculiarly characterized by the possession of compound eyes on each side of the head, which are distinctly divided into two parts by the sharp lateral margins of the head. They are of slight economic value, though destroying some mosquito larvæ.

Tribe **Clavicornia.**

This tribe comprises those beetles which have clubbed antennæ.

The family **Hydrophilidæ** are the "water-scavengers," usually black in color, though some have orange or red markings along the margins, convex above, flattened below, smooth and polished, and possessing short antennæ, which are clavate or clubbed. Certain of the smaller species are small, and have a rough body wall, and crawl on the bottom of ponds and streams instead of swimming, and still others are land forms. One species, *Hydrophilus triangularis*, is often seen flying about electric lights. All live on decaying matter, but are of slight economic importance.

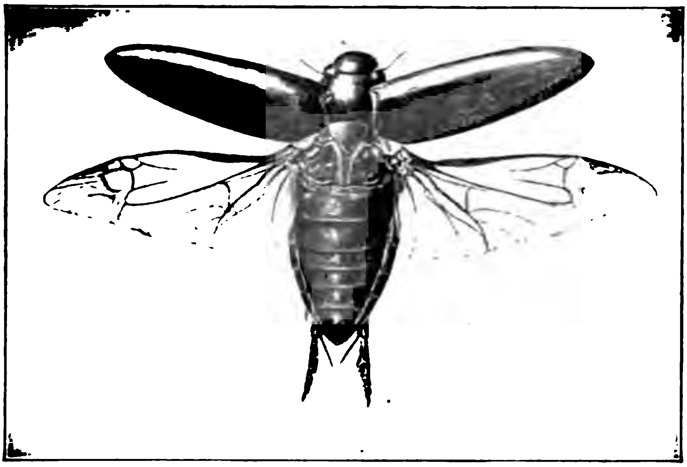


FIG. 87. *Hydrophilus triangularis.* Natural size.

The family **Staphylinidæ**, or rove-beetle family, is a large and widely distributed group, its members being characterized by the possession of short, leathery wing-covers, which leave the abdomen exposed. They live in decaying animal or vegetable matter, excrement, or in flowers. In the spring, certain tiny flower-inhabiting forms take to flight in great swarms, get in the eyes of travelers and become very annoying on account of their acrid body-fluids.

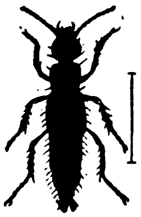


FIG. 88. Rove-beetle (*Staphilinid* sp.).

The **Silphidæ**, or "burying-beetle" family, are found on carrion and in fungi. The antennæ are terminated by a short spherical club, in which are the very sensitive organs of smell, and the wing-covers are slightly shortened. The thick-bodied beetles, black marked with red, and with the habit of digging under small animals until they are buried, belong to the genus *Necrophorus*, and are the burying-beetles proper.

The genus *Silpha*, or roving carrion-beetles, are short, broad, flat, black in color, and have longitudinally grooved elytra.

The **Cucujidæ** are a family of small beetles, light brown in color, flat and narrow in shape, well fitted for their habitat under the bark of trees. One species, *Silvanus surnamensis*, the saw-toothed grain-beetle, infests stored grain and dried food products of all sorts.

The **Dermestidæ** are the beetles commonly known as the buffalo-moths and carpet-beetles. They are small, stout, oval forms with weak legs, and feed in all stages on stored animal and vegetable products, dried insect specimens, furs, feathers, stuffed animals, and on cheese and dried meats. Among the worst pests in this family are *Anthrenus scrophulariæ*, the carpet-beetles, known in the larval stage as the buffalo-moth; *A. varius* and *A. museorum*, the museum pests; and *Dermestes lardarius*, the larder-beetles.

The family **Parnidæ** are generally known as "water-pennies," on account of the flat, crustacean-like larvæ, which cling to stones. The adults are non-swimming, but crawl about on submerged objects.

Tribe **Serricornia.**

This tribe is composed of beetles with slender, serrated, saw-toothed antennæ.

The **Buprestidæ** is an important Serricorn family, both economically and numerically, its members being commonly known as the metallic wood-borers. These beetles have a compact, elongate body, short, serrate antennæ; the head is deeply inserted in the prothorax, and they are always metallic and iridescent in their coloration. Their larvæ are flat-headed, legless, tadpole-shaped wood-borers, making broad, shallow galleries and chambers under the bark of trees.

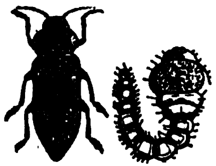


FIG. 89. Flat-headed apple-tree borer (*Chrysobothris femorata*).

The apple-tree borer (*Chrysobothris femorata*) is a greenish-black beetle, half an inch long, which lays its eggs on the bark of apple, peach, plum, and several forest trees. The newly hatched larvæ bore through the bark to the sapwood, where they burrow around and often girdle the tree. The Sinuate pear-borer is another very serious pest in the Eastern States.

The **Elateridæ** resemble the Buprestidæ in shape, but their lack of metallic colors, being usually blackish, brownish, or grayish, and the backward projecting angles of the prothorax, readily distinguish them from that family. On account of their power of springing up in the air when laid down backwards, they are called click-beetles. The larvæ are the "wireworms," and are long, slender, slightly flattened, and

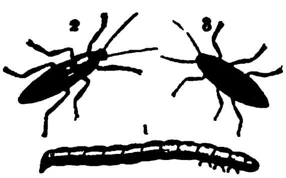


FIG. 90. Click-beetles (*Elatrids*) and larva (wireworm).

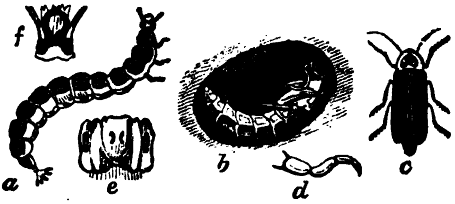


FIG 91. Firefly (*Photinus pyralis*). *a*, larva; *b*, pupa in underground cell; *c*, adult; *d-f*, enlarged details of larva.

leathery in texture. The larvæ live underground, and require two or three years to complete their growth. They are very destructive to sowed grain, root crops, meadow land and strawberries.

The insects commonly called fireflies are not flies at all, but beetles belonging to the family **Lampyridæ.** Only a few species are luminous, however, and these belong mainly to the genus *Photinus.* (See Fig. 91.) The soldier-bugs are diurnal members of this family, of the genera *Chauliognathus* and *Telephorus.* *T. bilineatus* does much good in the Eastern States, as it eats quantities of plum-curculio larvæ.

The family **Cleridæ** are called "checker-beetles," or "flower-beetles," from the conspicuous black, white or red checkered markings on the body, and from their habit of living on flowers. The antennæ are serrate or slightly clubbed, and from the slenderness of the body and their habits of running swiftly about they look decidedly ant-like. With one exception, those of the genus *Necrobia,* the larvæ are all predatory on the larvæ of wood-boring insects and in bees' nests. *Necrobia rufipes,* the red-legged ham-beetle, lives on ham and other stored animal products; but, on the whole, the family is a very useful one.

The **Ptinidæ** are nearly all injurious forms, living on dried vegetable matter. They are small brownish beetles, with strange tastes in the selection of foods. The drugstore-beetle (*Sitrodrepa panicea*) attacks all sorts of drugs and herbs, many of them noxious and poisonous to us. *Lasioderma serricornea* lives on tobacco in any form, and is called the cigarette-beetle. Others are destructive to books and paper, or are borers, such as the apple-twig borer. Certain species, belonging mainly to the genus *Aniobium,* have gained the name of "death watches," on account of their habit of rapping their heads against wood or some hard object.

Tribe **Lamellicornia.**

This tribe contains two families, the Lucanidæ and the Scarabæidæ.

The **Lucanidæ** are rather rare, curiously formed beetles, with elbowed, clubbed antennæ, and large, often branched mandibles. From the latter character they have received the name of stag-beetles. The larvæ are white grubs living in decaying wood, while the adults live upon honey-dew, and on sap which flows from wounds in trees.

The **Scarabæidæ** is, numerically, a very large family, and its numbers vary greatly in shape, size, and feeding habits. They all have antennæ with a club at the tip composed of from three to seven lamellæ, and the fore tarsi are formed for digging. The larvæ are white grubs, which live in decaying vegetation or excrement, or in the ground on

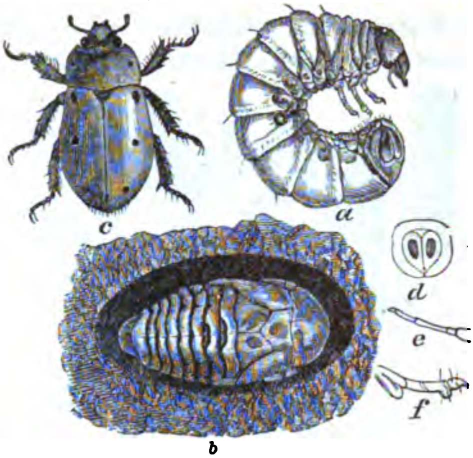


FIG. 92. Grapevine beetle (*Pelidnota punctata*). *a*, larva: *b*, pupa; *c*, beetle; *d*, antennæ; *f*, leg, enlarged.

the roots of plants. There are two groups in this family: the scavengers, of which the tumble-bugs are examples, and the leaf-chafers, represented by the "May-beetles" and "June-beetles." *Macrodactylos subspinosus*, the rose-chafer, a yellowish beetle with pale red legs, does great damage to roses and grapes and other flowers and fruits.

The genus *Lachnosterna* contains the "June-beetles," or "bugs," from whose attacks lawns and root-crops suffer.

The rhinoceros-beetles belong to the genus *Dynaste*, and are so named on account of large horns on the head, and another larger horn, accompanied by two smaller ones, projecting forward from the prothorax.

There are several genera of flower-beetles, one of the commoner forms being the "bumble flower-beetle," *Uphoria inda*. It is yellowish brown and hairy, and in early spring is seen flying near the ground with a loud buzzing noise.

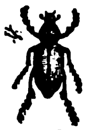


FIG. 93. Rose-chafer (*Macrodactylos subspinosus*).

Section **TETRAMERA** or **PHYTOPHAGA**.

This section comprises those beetles which, apparently, have four segmented tarsi, the fourth segment being so fixed with the third as to be indistinguishable. There are four families under this section, and among them are very many of our worst crop enemies.

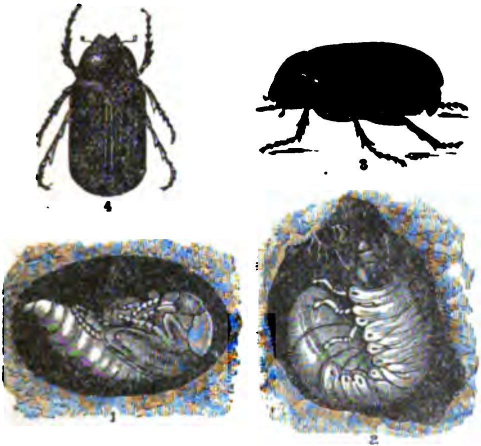


FIG. 94. June-bug or white grub. 1, pupa; 2, larva; 3-4, adults.

The family **Chrysomelidæ** is one of the largest of the beetle families and probably contains more injurious forms than any other. They are generally small, oval forms, strongly convex above, possessing small heads and widely separated antennæ. The adults, when disturbed, have the habit of folding up the legs and dropping inert to the ground.

The Colorado potato-beetle, asparagus-beetle, and elm-leaf beetle are some very destructive species which have not yet reached California. *Diabrotica* we have in plenty, however; *D. vittata*, the cucumber-beetle, a greenish yellow form with two black stripes on each wing-cover; *D. soror*, the flower-beetle, a 12-spotted greenish form, being familiar pests. *Chrysochus cobaltinus*, a large, bright blue beetle, is a noticeable Chrysomelid, and the smaller, though not less destructive, flea-beetles belong here also. *Haltica chalybeus*, a blue grape-feeding flea-beetle, and the black cucumber flea-beetle (*Crepidodera cucumeris*), feeding on cucurbits, represent these destructive insects. *Lena californica* is a small blue beetle found on dock, and *Lena scripta* on willow.

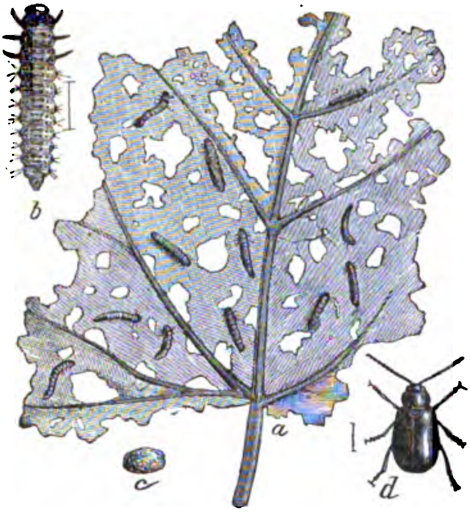


FIG. 95. Grapevine flea-beetle (*Haltica chalybeus*).

The black-legged tortoise-beetle (*Cassida nigripes*) represents a genus of bright golden-colored Chrysomelids of a peculiar shape, which are most often found feeding on the leaves of the sweet potato.

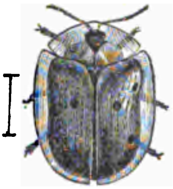


FIG. 96. Black-legged tortoise-beetle (*Cassida nigripes*).

The family **Bruchidæ** is small, and consists of beetles which are short and chunky, with the elytra cut off behind, with small head, and thighs swollen as if from jumping, and which in all stages live on stored seeds. *Bruchus pisi*, commonly known as the pea-weevil, and *B. obtectus*, the bean-weevil, are cosmopolitan species.

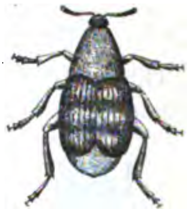


FIG. 97. Bean-weevil (*Bruchus obtectus*).

The **Cerambycidæ** have antennæ as long or longer than the body, and are primarily a wood-boring family, being commonly called the long-horned wood-borers. The bodies of these beetles are usually cylindrical and elongate, though some are flattened, and their mandibles are stout and sharp-pointed. The larvæ are known as the round-headed borers, to distinguish them from the flat-headed Buprestids. Over 600 species are known, most of them living in dead or dying wood, although some attack healthy tissue.

The round-headed apple-tree borer (*Saperda candida*) is a pale-brown beetle, with two broad whitish longitudinal stripes. The larval life is three years, the first part being spent in the sapwood and the later, and pupal stages, in the heartwood. The "pruners" are species living in and eating out the hearts of twigs of maple, oak, apple, pear, plum, and other trees, so that the wind blows them to the ground.

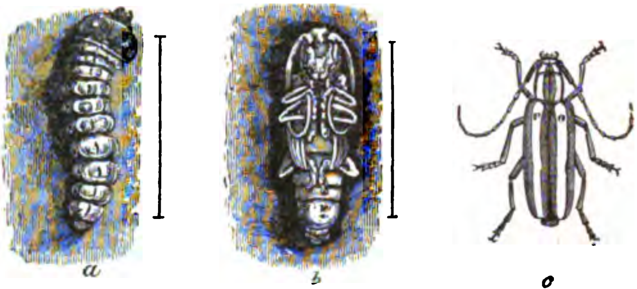


FIG. 98. Round-headed apple-tree borer (*Saperda candida*). *a*, larva; *b*, pupa; *c*, imago.

Our great sugar and yellow pines are attacked by a large Cerambycid, *Ergates spiculatus.* The genus *Prionus* has some large species, the larvæ of which are two and one half to three inches long and which live in the roots of apple and cherry trees, and of grape and blackberry vines.

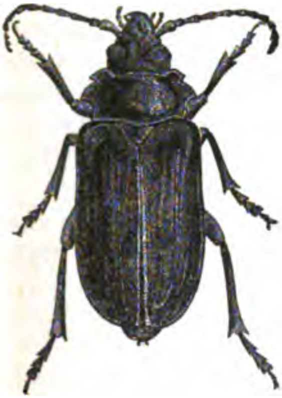


FIG. 99. California pine-borer (*Prionus californica*).

Section TRIMERA.

This section contains only one family, the all-important beneficial one, the **Coccinellidæ**, or ladybirds. They are small, hemispherical beetles, usually red or yellow with black spots, or black with red or yellow spots. The tarsi have only three joints, so that if confused with certain Chrysomelids, as they sometimes are, this character serves to readily distinguish them. With one exception, the genus *Epilachna*, they are all predatory, both larvæ and adults, on plant-lice, scale insects, and other soft-bodied plant-feeding insects. The larvæ are slender and fusiform in shape, with roughened spiny bodies, often prettily marked with blue, black, and orange.

Hippodamia convergens is a very common native form, feeding principally on plant-lice (aphids). It is yellowish red in color, with six black spots on each wing-cover. *Coccinella californica* is a similar form, but more rounded and lacking the spots. *C. sanguinea* is a small, blood-red form. *C. abdominalis* is the ashy gray ladybird with seven small black spots on the thorax and eight on each wing-cover. *Chilocorus bivulnerus*, the "twice-stabbed," is a large black ladybird, with a large red spot on each wing-cover, very destructive to the armored scales. *Coccinella oculata* is a still larger form often taken for the "twice-stabbed" ladybird. *Exochomus pilatei*, "Pilate's ladybird," also resembles the "twice-stabbed," but the under side of the abdomen is black instead of red. It feeds on black scale, but does not increase rapidly. *Psyllobora 20-maculata*, the "20-spotted ladybird," is a common species, feeding on young scale and the red spider.

Of the ladybirds introduced by the State Commission of Horticulture, *Vedalia cardinalis*, *Rhizobius ventralis*, *R. twoombeæ*, *Novius koebelei*, *Orcus chalybeus*, *Cryptolæmus montrouzieri*, *Scymnus vagans*, *S. marginicola*, *Rhizobius debilis*, *Rhizobius lopantha*, and *Hyperaspis lateralis* have proved the most successful. *Vedalia cardinalis* and *Novius koebelei* have completely subjugated the cottony-cushion scale. *Orcus chalybeus* is effective against the yellow scale. *Rhizobius ventralis* is a very useful destroyer of the black scale. *Scymnus vagans* is an enemy of the red spider. *Rhizobius lopantha* makes some headway against the purple scale, and *Cryptolæmus montrouzieri* cleans up the mealy-bugs in greenhouses. The other species are general feeders.

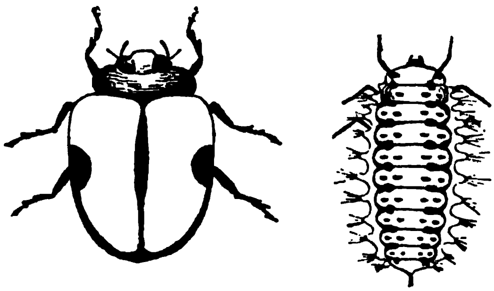


FIG. 100. *Novius koebelei.*

If it were not for these industrious enemies of our fruit and vine pests, California would be far from ranking to-day the chief fruit-producing State of the Union.

Section **HETEROMERA.**

This section is a rather miscellaneous lot of beetles, including several small obscure families, as well as two large ones. All those beetles which have the front and middle feet with five tarsal segments and the hind feet with four are included in it.

The family **Tenebrionidæ** are the "darkling beetles." They are usually dark brown or black in color, oblong or oval in shape, have the head more or less inserted in the prothorax, and, on account of their long legs, are very awkward in their movements. Both adults and larvæ are scavengers, the latter much resembling wireworms in appearance. The common pinch-bug, *Eleodes* sp., which when disturbed stands on its head and emits an ill-smelling fluid, is a familiar type. The meal-worm beetle (*Tenebrio molitor*), bred by bird fanciers for food, and *Tenebrio obscurus*, found about stored grain products, are cosmopolitan species.

The family **Meloidæ** are called blister-beetles, because their bodies when dried and pulverized are used therapeutically as blisters. In the adult stage they feed on plant tissue, and are sometimes injurious. In the larval stage many are, however, markedly beneficial, such as the larvæ of *Epicauta vittata*, which live on the egg pods of grasshoppers. The life cycle of many species has reached a highly specialized development and their study is exceedingly interesting.

The **Stylopidæ** is an obscure family, most of its forms being parasites on wasps.

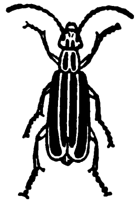


FIG. 101. Striped blister-beetle (*Cantharis vittata*).

Suborder RHYNCOPHORA.

The suborder Rhyncophora, or snout-beetles, consists of beetles characterized by the peculiar prolongation of the front of the head into a beak or snout, at the end of which the mouth parts are situated. The curculios, bill-bugs, and most of the weevils belong to this suborder, and are great pests, living as they do on vegetable matter, stored products, and the like.

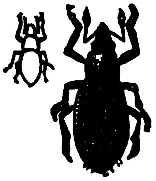


FIG. 102. Fuller's rose-beetle (*Aramigus fulleri*).

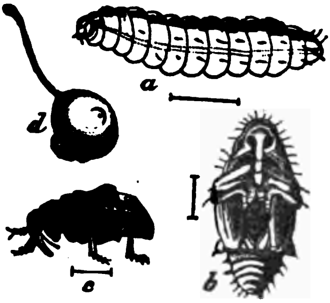


FIG. 103. Plum curculio (*Conotrachelus nenuphar*). *a*, larva; *b*, pupa; *c*, adult; *d*, curculio at work.

The family **Otiorhynchidæ** are the beetles which have a scar on the front of the upper side of each mandible. Fuller's rose-beetle, a species attacking roses and orange trees, is a familiar type.

The family **Curculionidæ** lack the scar, and are the typical curculios and weevils. The cotton-boll weevil, strawberry weevil, and the plum-curculio are well-known pests belonging to this family.

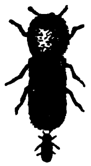


FIG. 104. Pine-tree scolytus (*Scolytus pyri*).

The **Calandridæ** include the bill-bugs and rice and granary weevils. The latter two forms, *Calandria oryzea* and *C. granaria*, are world-wide in distribution and do immense damage to stored grain.

The **Scolytidæ** are the engraver-beetles. According to Pinchot, the annual losses caused by these insects total nearly $100,000,000. The Monterey pines of California are attacked by two species, *Dendroctonus valens* and *Tomicus plastographus*, to such an extent that entire forests have been killed by them. Others, such as the fruit-bark beetle, attack and kill peach and plum trees.

Order **HYMENOPTERA.**

(Bees, Wasps, Ants, Saw-flies, etc.)

This, of all the orders, is the one which may be said to be wholly beneficial to man, for while, as there is a black sheep in every flock, there are injurious species in the Hymenoptera, they are so largely the exception to the rule that we may say that the order Hymenoptera is the one wholly beneficial order of insects. In this order we find the several species of honey-bees, which supply us with honey and wax; an immense number of parasitic insects, which keep down any redundancy on the part of the injurious species; and the ants, which act as scavengers. The whole of the wasp family are beneficial, for, in providing for their young, the larger members stuff their cells with spiders, caterpillars, and other insects, and they are all predaceous in some form. It is in this order, too, that we find the highest development of the social instinct, for many of the species are so constituted that they can not exist except in communities, and in these communities we find the most perfect system of division of labor imaginable. With the social bees, for instance, we have one mother bee, whose sole duty is to supply the eggs from which the stock of workers is to be kept up; the drones, or males, whose sole duty is to act as fathers of the hive; the third class are the workers, and these are again divided into outside workers, inside guards, nurses, and other classes, each of which has its special duties to perform, and upon the proper performance of which the welfare of the whole community depends—and they never fail in their duty. In this order, too, we find the only class of insects which care for their young. In all others the eggs are laid as it happens. Usually instinct directs the female to choose a position which will supply food for the young when hatched, but, this done, she is through with them and gives them no more care. But in this order we have species which diligently watch over the eggs, take charge of the young when hatched, attend to them, feed them with proper food, and watch over them in every stage of their growth until they have passed through all the changes, entered the ranks of the mature workers and are ready, in their turn, to perform the same duties for their successors.

The name Hymenoptera is compounded of two Greek words, *hymen*, membrane, and *pteron*, wing. The name is not altogether distinctive, however, as all insects possessing membranous wings are not members of this order, but all members of this order have four membranous wings. A peculiarity of this order is that the hinder pair of wings are provided with a series of hooks, with which they catch the fore wings, and thus the two pairs are connected closely together. Another feature is that while in all other insects the mouth parts are made for either biting or sucking, in this order they are so arranged as to be of use for both purposes.

The three divisions of the body are well defined. The head is, in many species, movable on the thorax, while the thorax is sharply divided from the abdomen, in some cases, as in the wasps, being joined by a mere thread-like process.

The metamorphosis of the Hymenoptera is complete. The eggs are not remarkable for either form or color, and are usually somewhat oblong. They are laid in various positions, according to species, in some cases being deposited in the bottom of cells prepared to receive them; in others, as in the parasitic species, being attached to or placed in the body of their victims. In all, except the two lower families, the larvæ are maggot-like creatures, footless, and incapable of extended motion, and, in many cases, wholly dependent for their existence upon the care of the adults.

This order is divided into two suborders, the *Terebrantia* and the *Aculeata.* The former comprises a number of parasitic insects, as the ichneumons, braconids, chalcids, etc., the gall-flies, saw-flies, etc.; while the latter includes the stinging forms, as bees, wasps, and ants.

Suborder **TEREBRANTIA.**

In the modern system of classification it has become the rule to commence with the lower forms and work upward to the higher, and, for this reason, the Hymenoptera, being recognized as the highest developed of any of the members of the insect world, is placed at the top of the list. In this arrangement the various orders and families may be compared to a pyramid, in which the less specialized, lower, and baser kinds form the foundation, and in which there is a constant ascent until the capstone is reached, and, in this case, this is the higher order of Hymenoptera. So, in accordance with this plan, the suborder Terebrantia, which is the less specialized of the two suborders, and contains the lower forms of the order, takes its place first in our consideration, and in this the lower families are first noticed.

Comstock gives us the following synopsis of the suborder Terebrantia:

THE BORING HYMENOPTERA. Suborder Terebrantia.
- *The Plant-eating Hymenoptera.*
  - The Saw-flies. Family Tenthredinidæ.
  - The Horn-tails. Family Siricidæ.
- *The Gall-inhabiting Hymenoptera.*
  - The Gall-flies. Family Cynipidæ.
- *The Parasitic Hymenoptera.*
  - The Trigonalids. Family Trigonalidæ.
  - The Ichneumon-flies. Family Ichneumonidæ.
  - The Stephanids. Family Stephanidæ.
  - The Braconids. Family Braconidæ.
  - The Ensign-flies. Family Evaniidæ.
  - The Chalcid-flies. Family Chalcididæ.
  - The Proctotrupids. Family Proctotrupidæ.

Family **Tenthredinidæ** (Saw-flies). In this family the females are provided with a pair of saws, which are concealed in a cavity of the abdomen when not in use. With these she cuts a slit in the leaves or stems of plants upon which she lay her eggs, and it is this fact which gives its common name to this family. The larvæ are small, slimy-looking insects, somewhat resembling caterpillars, but they have from twelve to sixteen prolegs, while caterpillars, with one exception, have but ten. They are a serious pest upon plants infested by them, and examples of this family may be instanced in our common cherry-slug (*Eriocampa cerasi*) (which also infests the pear), the rose-slug, and the currant-worm.

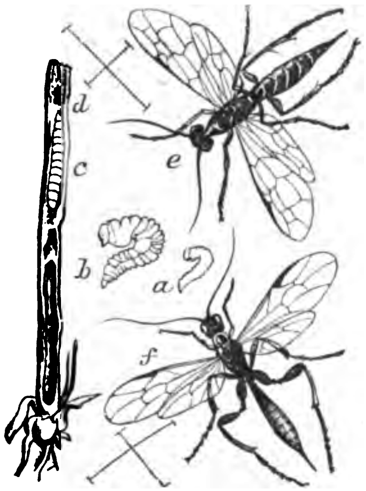


FIG. 105. Corn saw-fly (*Cephus pygmæus*). *a*, larva; *b*, larva. enlarged; *c*, larva in wheat stalk; *d*, frass; *e*, adult female; *f*, its European parasite (*Pachyonerus calcitrator*). (From "Insect Life.")

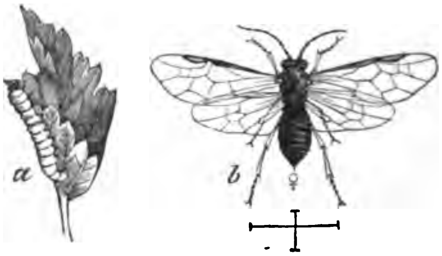


FIG. 106. Currant-worm (*Pristophora grossulairæ*)

Family **Siricidæ** (Horn-tails). This family is closely connected with the foregoing family, but differs from it in the shape and uses of the ovipositor. Instead of being a sawing instrument, as in the former, it is a very complicated and effective boring tool, by means of which the female can drill a hole in the hardest wood, in which she deposits her egg. The habits of the larvæ are also very different, those of the horn-tails being boring insects, and they sometimes do great damage to forest timber and shade trees. Members of this family are of large size, the pigeon tremex (*Tremex columba*), which is not uncommon in our State, being as large around as a pencil, and sometimes an inch and a half in length.

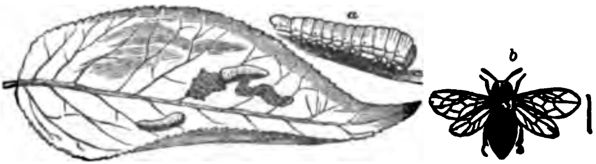


FIG. 107. Cherry-slug (*Eriocampa cerasi*). *a*, larva on leaf and larva enlarged; *b*, adult saw-fly.

These two families are practically all of this order which are injurious, or not beneficial to man. The gall-flies, which come next, when very numerous, may do some damage to vegetation, but the extent of this is trifling.

Family **Cynipidæ** (Gall-flies). In this family we have one of the mysteries of the natural world. Here we have a minute insect, in some cases almost microscopic in size. This insect will puncture a twig or leaf of a tree, and at once the whole character of the part so punctured is changed. In the oaks, for instance, we see galls known as oak apples, and often they are as large as big apples, and these are formed for the purpose of supplying sustenance to the tiny maggot of a gall-fly. What kind of fluid is injected to cause this change? It certainly is wonderfully powerful, as the amount injected must be so infinitely small as to be past our comprehension, for it is but a part of the insect and this is not large enough to be noticed. More than this, each species creates a special kind of gall, and an entomologist can tell what species of insect did the stinging by the shape, color, and general appearance of these strange swellings. Now, how is it that the plant will accommodate its growth to the peculiar requirements of each one of the different species of these minute insects?

It must not be understood, however, that all the members of this family are gall-makers, or that there are no galls caused by other insects. In fact many of the other orders have gall-makers, as the aphids, the mites, etc.; but there is this difference: in other galls there are external openings, while in the galls made by members of this family they are closed and contain the larvæ of the insect until they have attained their growth. In some cases the insect goes through its transformations within the gall, and in others it makes its escape and changes in the earth.

Family **Ichneumonidæ.** We have now come to a family of especial interest to the fruit-growers and farmers of California as well as elsewhere, for in the Ichneumonidæ are found the greater number of our beneficial insects; that is, they are of benefit to us, as they prey upon species which devour and destroy our vegetable products. It is to this family that Swift's oft misquoted lines apply:

> "Naturalists observe, a flea
> Hath smaller fleas that on him prey,
> And these have smaller still to bite 'em,
> And so proceed *ad infinitum.*"

It should be borne in mind that there are two classes of beneficial insects, the *parasitic* and the *predaceous*. In the latter the insect pounces upon his victim wherever he catches him, that is, if he happens to be hungry, and devours him on the spot. The parasitic insects, however, have a neater way of doing business. In their proceedings they are not so coarse as the predaceous varieties, although they accomplish their work more effectively. They attach themselves early in life—in fact, the mother usually brings about the match—and, once attached, they remain until there is nothing left of their victim worth bothering about. They are quiet and insidious in their efforts, but never let go. Some of them get on the inside of their host, in which case they eat him out of house and home before they quit; in other cases they take an attachment on his outside and cling closer than a brother so long as he has a drop of blood in his body. But, however they do it, the result is the same to us; they get away with our foes, so we declare them our friends. But, bearing out Swift's doggerel, there are other parasites on these—secondaries, or hyperparasites, we call them—and some parasites on these again—tertiaries. So that, in importing beneficial insects, we are always very careful to see that there are no secondaries to escape and prey upon them before they are turned loose. Usually, when the egg is laid upon the body of the victim insect, as soon as it is hatched the young larva proceeds to work its way to the inner portions of its host, where it lives secure and waxes fat on his substance. By a strange instinct, however, it carefully avoids the vital portions, and so the host insect lives in misery until its parasite has acquired its growth, when it dies.

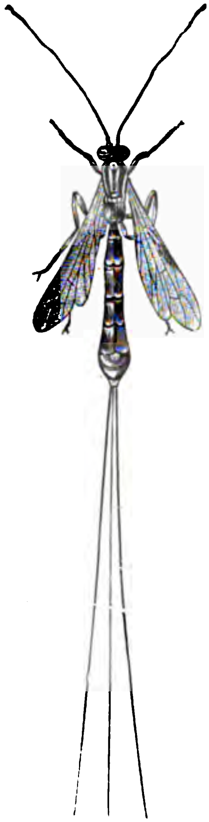


FIG. 108. *Thalessa lunator*, ichneumon parasite of pigeon tremex (*Tremex columba*).

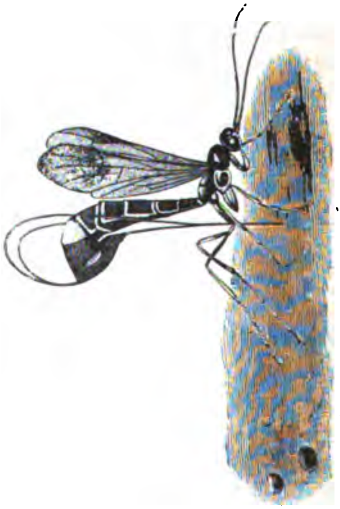


FIG. 109. *Thalessa lunator* drilling a hole in a tree-trunk in order to deposit eggs in the burrow of the pigeon tremex (*Tremex columba*).

While some of the members of this family are of small size, many of them are large, for parasitic insects. The *Caliephilates messer* Grav., of which we give an excellent colored illustration elsewhere, is a member of this family. This is a new species in the United States, introduced for work on the codling-moth, of which it has been found a very effective parasite.

The females of some species of this family are remarkable-looking insects, having an exaggerated ovipositor, which appears like a long tail. This, when folded, looks like one piece, but is really composed of three pieces: the ovipositor proper, and two guards, which form a sheath. The ovipositor itself is composed of three parallel pieces, one above and two below, joined together; near the end they are toothed like a saw, and between them is the egg passage. In the larger species, the females seem possessed of a special sense by which they ascertain whether their victim has already been attacked. If it contains an egg, they abandon it for another. This, for the reason that the food supply would not be sufficient for two large larvæ. With the smaller species, however, it is not uncommon for the female to lay a number of eggs on one victim. But it is not alone in their larval stage that insects are attacked by parasites, for they are subject to it at any stage of their existence, from infancy to age. Even in the egg, they are not immune, for there are egg parasites—minute insects, which lay their eggs within the eggs of other insects, which are eaten out by their internes.

The family **Stephanidæ** contains a few rare insects of no importance in this discussion.

The family **Braconidæ**, however, is a different matter, for this is a very extensive family of, generally, very small to medium sized insects, containing several thousand described species. All are parasitic on other insects, and in this we find many of the secondary and tertiary parasites. This family, in the older classifications, is included in the Ichneumonidæ, but well-defined differences in the two classes have led to the creation of the new family of Braconidæ. As parasitic insects, however, their habits of life are very similar, and to their efforts is largely due the fact that we are not entirely eaten out by the destructive pests. One of the chief checks on the aphids of our gardens is a minute member of this family, the genus *Aphidius*. Examine a twig or leaf infested with plant-lice, and you will see many of them bloated and white. Look closely and you will see a minute circular hole in the abdominal end. It is from this hole that the insect, after having eaten out the aphis, and gone through all its changes on the inside of the victim, has escaped. Gather a few

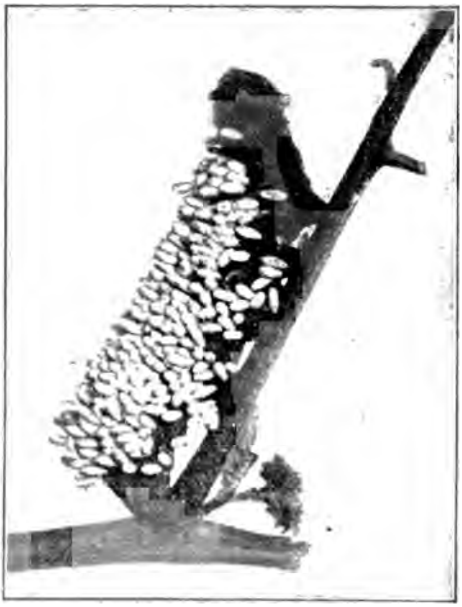


FIG. 110. Tomato-worm (*Phlegethontius sexta*), bearing cocoons of the parasitic *Apanteles congregatus*. Natural size.

of these aphis-infested leaves or twigs, place them in a small vial, and cover it with gauze. In a short time you will find numbers of a tiny, dark-colored insect, looking like a miniature wasp. This is a Braconid of the genus *Aphidius*. There are millions of them at work; each one eats an aphis, and afterwards lays hundreds of eggs on other aphids, which, in their turn, eat up their hosts. These insects of the parasitic class are usually small, and often so minute as to escape observation; but insignificant as they appear, we owe our very existence to them, for without their constant efforts we would be reduced to a condition of starvation by the hordes of pests, which, having no checks, would increase with enormous rapidity and soon overwhelm us like a flood.

The family **Evaniidæ** is a small one, closely connected with the Ichneumonidæ, but differing from them in structural characters. Its habits are similar, as it is parasitic.

The family **Chalcididæ** is an immense group, composed largely, but not wholly, of parasitic insects. As a rule, the members of this family are exceedingly small, many of them being microscopic, and some even requiring a high-power lens to bring them into view. Notwithstanding their minute size, however, they rank among the best friends the fruit-grower has, for they make up in numbers what they lack in size, and to the destructive pests of the fruit-grower they are as "terrible as an army with banners," for within the ranks of the Chalcididæ is comprised the largest number of species of any of the parasitic Hymenoptera, extending into many thousands. The members of this order are very small, and, as a rule, lack the attractive beauty of some of the larger insects, and so have been much neglected by entomologists. Dr. L. O. Howard, Chief of the Bureau of Entomology of the United States Department of Agriculture, has devoted much time to the study of this family, and to him, more than to any one else, science is indebted for its knowledge of this interesting and valuable group. Most of the species are parasitic, and most of them confine their attacks to one class of insects. Some of them, unfortunately, attack some of our beneficial insects, so that they are not wholly beneficial from our viewpoint.

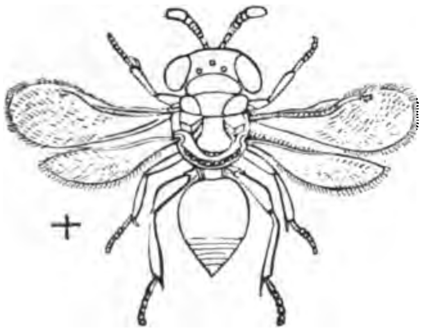


FIG. 111. *Tomocera californica*, a chalcid parasite of black scale (*Saissetia oleæ*). Female, very greatly enlarged.

In speaking of this family Professor Howard says: "Nowhere in nature is there a more marked example of the co-relation between structure and habits than occurs in this family. This co-relation descends to the relation between the parasites and their hosts, so that it is possible for an experienced person on seeing a new species of Chalcid fly to tell precisely what kind of an insect it will be found to be parasitic upon. For example, the species of the genus *Copidosoma* are always parasitic within naked caterpillars. Those of the genus *Bothriothorax* are always parasitic in small dipterous larvæ. The economic importance of the group is great. They are the most effective parasites of many of our most injurious insects. For example, in a certain year in the cotton fields of northern Florida ninety-five per cent of the eggs from which would have hatched the voracious cotton-caterpillar were killed by the minute Chalcid parasite, *Trichogramma pretiosa*."

In our own State, the different species of this family form one of the most efficient checks on scale pests, usually burrowing into the scale and eating it out. How exceedingly minute some of them are is indicated by the fact that the red, yellow, and San José scales are all parasitized by members of this family, and, within the bodies of these insects, none of which are larger than the head of a pin, these little flies have ample room to live, grow, pass through all their changes, and emerge as perfect insects. We have often found from three to five parasites belonging to this group snugly ensconced within the body of a soft brown scale, and there was ample room for all without crowding.

Some of the Chalcids attack larger insects, and the cabbage-butterfly is largely kept down by the efforts of one of them, *Pteromalus puparum*, which lays its eggs on the caterpillar and reduces it to a state of "innocuous desuetude." One branch of the family closely approaches the gall-flies in structure and habits.

The family **Proctotrupidæ** contains the smallest members of the Hymenoptera. They are all parasitic, many of them being parasitic on the eggs of other insects. How small they are may be understood by the statement that, in some cases, as many as half-a-dozen of them will live and pass through all their changes within one minute egg of an insect, moth, butterfly, or bug. Some live in the larvæ of other insects, some exist wholly in the nervous system, others in the digestive tract. The largest of them is not over one twenty-fifth of an inch in length, while the smallest (*Alaptus excisus*) measures between six and seven one-thousandths of an inch.

Suborder ACULEATA.

We now come to the second branch or suborder of the Hymenoptera, which includes the species armed with stings. Most of our readers have made acquaintance with them, as the group includes the wasps, hornets, bees, and ants. These are divided into families as follows, according to Comstock's classification:

- THE STINGING HYMENOPTERA. Suborder Aculeata.
  - The Pelecinus. Family Pelecinidæ.
  - The Cuckoo-flies. Family Chrysididæ.
  - The Ants. Superfamily Formicina.
    - Family Formicidæ.
    - Family Poneridæ.
    - Family Myrmicidæ.
  - The Digger Wasps. Superfamily Sphecina.
    - The Velvet-ants. Family Mutillidæ.
    - The Scoliids. Family Scoliidæ.
    - The Sapygids. Family Sapygidæ.
    - The Spider-wasps. Family Pompilidæ.
    - The Thread-waisted Wasps. Family Sphecidæ.
    - The Ampulicids. Family Ampulicidæ.
    - The Larrids. Family Larridæ.
    - The Bembecids. Family Bembecidæ.
    - The Nyssonids. Family Nyssonidæ.
    - The Philanthids. Family Philanthidæ.
    - The Mimesids. Family Mimesidæ.
    - The Mellinids. Family Mellinidæ.
    - The Pemphredonids. Family Pemphredonidæ.
    - The Crabronids. Family Crabronidæ.
  - The True Wasps. Superfamily Vespina.
    - The Guest Wasps. Family Masaridæ.
    - The Solitary Wasps. Family Eumenidæ.
    - The Social Wasps. Family Vespidæ.
  - The Bees. Superfamily Apina.
    - The Short-tongued Bees. Family Andrenidæ.
    - The Long-tongued Bees. Family Apidæ.

It is in this suborder that we find the fullest development of the social instinct. With the social bees, wasps, and ants, every interest is sacrificed for the good of the community. Here

> "None is for himself,
> But all are for the state."

None of the members of this suborder are of direct importance to us, being beneficial only incidentally. The wasps are all predaceous, many of them preying upon the larvæ of injurious species, while the work of the bees is too well known to need enlargement in these pages. Probably we owe more to this group for their work in the pollenization of plants and fruits, perhaps in the cross-fertilization of species—hybridization—and probably even the production of new species, than for any other benefits they render us. Were it not for their labors in this direction, aided by other insects, true, and perhaps to some extent by other means, it is not improbable that a very large part of the vegetable world would perish and man and other members of the animal kingdom suffer correspondingly. A cursory glance at the various families comprising this suborder is, therefore, all that is required in this place.

The family **Pelecinidæ** is a very small one, in which the distinguishing peculiarity is the great length of the abdomen in the female.

The family **Chrysididæ**, better known as the cuckoo-flies, have the habit of the bird after which they are named, of laying their eggs in the nests of other wasps and leaving them to be fed by the owner of the nest. As the larva develops, it either turns out the proper occupant of the cell or devours it. They are beautiful insects, the body being a brilliant metallic green.

Superfamily **Formicina.** (Ants.)

The ants have been erected into a superfamily called Formicina, and this superfamily is divided again into three families: the **Formicidæ**, **Poneridæ**, and **Myrmicidæ**. Ants are so distinct from all other insects, and so well known to most people, that no description is needed here. There is but one other class of insects likely to be mistaken for them, the Termites, which are not ants at all, although called "white-ants." These do not at all resemble ants in appearance, either in form or in color, but being communistic insects have somewhat the habits of ants in this regard. Termites resemble ants in the fact that they congregate together in immense numbers, and are divided into different classes, each class having separate and well-defined duties to perform in the community. Aside from this their habits are entirely different.

All the species of ants are composed of three classes of individuals: males, females and neuters, or workers, which latter are really undeveloped females. All ants live in communities of greater or less extent, and in some cases these colonies are exceedingly populous. By what system of laws these densely populated communities are governed is unknown, but it is known that each class performs its appointed duties without let or hindrance and that all move smoothly and harmoniously. The workers perform all the work of the colony, and their numbers exceed the other classes many times over. There are usually several perfect females whose sole duty is to maintain the strength of the colony, and for a short time during the early summer a great number of young females and males are produced. These quit the nest together, never to return. They are the ones which found new colonies, and out of thousands which start forth, vast numbers of them perish, falling a prey to birds and other causes. There is much that is fascinating in the life of an ant, and these insects have been a great favorite with entomological students even from the time of Solomon, as is indicated by his advice: "Go to the ant, thou sluggard; consider her ways and be wise." Many books have been written of them, and when we consider their intelligence and that in many respects they resemble man, it is not strange that we should be interested in them. We find among them a perfect system of government; also a highly specialized division of labor, many of our trades being represented, such as architects, builders, agriculturists, tailors, masons, and many other trades corresponding to those followed by man. The rare intelligence exhibited by ants in attending to and caring for their young is astonishing. They watch the eggs and larvæ night and day, and remove them from place to place, as they require more or less light, warmth, and moisture. When an ants' nest is disturbed the workers first of all secure the young and take them to a place of safety, this instinct being even greater than that of self-preservation, for they will risk the greatest dangers and their own lives for the eggs and cocoons of the young insects. That they are able to communicate and transmit intelligence is evident, too, and this is done by means of their antennæ. They play like children when they have leisure, and have so many striking peculiarities that there is a charm in them for those who are not interested in entomology.

They have, however, little economic importance, for, except incidentally, they are neither hurtful nor beneficial. If anything rather the former, as, in their efforts to get the exudation of honey-dew from aphids and scale-bugs, they often spread these insects into new locations, and they sometimes prey upon the soft larvæ of some of the lady-birds, and thus keep down our beneficial insects. The small red ant found in the house becomes a pest by reason of its enormous numbers, which increase in the summer. This is essentially a domestic species, having its nests in the walls and floors of our houses. It is sometimes very difficult to trace it, but usually by careful watching the location of the nest can be found, when it may be driven out by the application of coal oil to the runways.

Superfamily **Sphecina.** (Digger-wasps.)

The next superfamily is the Sphecina, and is composed of the solitary wasps, the digger-wasps, or *Fossores*. This name is given to them from the fact that each female makes a nest for herself, usually by burrowing in the ground or boring into wood. Some, as the so-called mud-daubers, construct tubes, while others use any suitable tunnels they can find, or even utilize the hollow stems of plants, in which to deposit their eggs and provide for their young. These nests are usually provided with food for the young wasps in the form of the preserved bodies of other insects or spiders. Many species provision their nests with caterpillars, others with spiders. The parent wasp possesses some kind of fluid which she injects into the victim, and which renders it apparently senseless, but which, instead of killing, preserves its life, and it will remain in this condition perfectly fresh until required by the larvæ of the wasps for food.

Comstock gives us fourteen families under the superfamily Sphecina, to most of which only a passing allusion is necessary.

The family **Mutillidæ** are the velvet-ants. The females are wingless and strongly resemble ants in appearance, but their bodies are covered with a dense growth of hair, which has given them their common name.

The family **Scoliidæ** very strongly resembles the foregoing family. Members of this family do not build a burrow, but find the larvæ of other insects in the ground, and upon these they lay their eggs, which, hatching, consume the host insect. So far, this wasp may be regarded as beneficial.

The family **Sapygidæ** is a small one, the members of which are usually found in the nests of bees. It has no economic importance.

The family **Pompilidæ** includes about a hundred and twenty species, and they are commonly known as the spider-wasps, on account of their habit of provisioning their nests with spiders, which they sting and reduce to a dormant condition. They are generally slender insects with long legs, and usually brilliantly colored and beautifully marked. While generally of moderate size, some of the species are very large, and here we find the well-known tarantula-hawk (*Pepsis formosa*).

The family **Sphecidæ** comprises the thin-waisted wasps, and includes the well-known mud-daubers. These are commonly known as the thread-waisted wasp, on account of the thin, thread-like process which connects the abdomen with the thorax, and which is composed of the first two segments of the abdomen. This family is a very conspicuous one and embraces about seventy species in the United States, most of them well known from their peculiar form and habits. They build their cells from mud, and stock them with spiders or caterpillars, after first depositing an egg in the bottom. When hatched, the young larva finds an abundance of preserved food awaiting it, and remains in the cell until it has passed through all the changes, when it emerges a perfect insect.

The family **Larridæ** is composed of moderate-sized insects, which frequent sandy locations.

The family **Bembecidæ** includes some of the larger forms of this order They make their nests in burrows, which they excavate in sandy places, and store them with flies. The larger species attack cicadas, and one may often be seen carrying away a cicada larger than itself.

The families **Nyssonidæ** and **Philanthidæ** are two groups of insects having the same general characters and habits as the foregoing, but differing in points of structure and wing venation.

The families **Mimesidæ, Pemphredonidæ,** and **Crabronidæ** are rather borers than diggers, although classed with the digger-wasps. They usually burrow into the stems of pithy shrubs and form their nests therein. As in all the other members of this order, these nests are stored with the preserved remains of other insects, so that all may be classed as beneficial.

Superfamily **Vespina.** (True Wasps.)

The true wasps are included in three families, grouped together in the superfamily Vespina. Insects belonging to this superfamily are all winged, and when at rest fold their wings lengthwise like a fan. The legs are not suited for burrowing. It is in this superfamily that we find the paper-wasps and nest-builders.

The three families under this group are the **Masaridæ**, the **Eumenidæ**, and the **Vespidæ**. The first of these is a small family of no importance in this place.

The second is a family of solitary wasps, the members of which vary in their habits, some being builders and some burrowers. Some of them build nests of mud, while others bore tunnels into wood in order to provide for their young.

The third family is of more interest, as it includes the social wasps, the nest-builders, and paper-makers. It is here that we find our well-known friends, the yellowjackets. These belong to the genus *Vespa*, and most of our readers, especially those who live in or have been in the country, are very familiar with their appearance and not unfamiliar with their mode of defense. Their nests, which are sometimes attached to buildings, trees, or fences, are made of paper, and are very elaborate specimens of architecture. Being social insects they accomplish some great works, and it is no uncommon thing to find one of these nests as large as a water-bucket. Sometimes they make their nests underground, either excavating a hole for the purpose, or taking possession of one already formed.

Superfamily **Apina.** (Bees.)

We now come to the bees, the last and highest of the Hymenoptera. It is here that we find the greatest intelligence displayed in the insect world. No insect has been so thoroughly studied as the bee. Books and libraries have been written about bees, and the most wonderful stories told of their intelligence, which would seem to far exceed anything we can call instinct and to closely approach human reason. They present to us the highest known type of social life, and the most perfect form of government.

Bees have been placed under the superfamily Apina, which is divided into two families, the **Andrenidæ** and the **Apidæ**, or the short- and the long-tongued bees. The habits of members of the different families vary greatly. Some are solitary, making a nest for themselves, and storing it with honey and pollen. Others can live only in communities. Some are very small, one of the mining-bees measuring but from one hundredth to three hundredths of an inch in length.

So far as relates to agriculture, bees are beneficial. They are not parasitic, like some of the other families of the order, although there are some bees parasitic on others, but in their work of gathering honey they are one of the greatest agencies in nature in the fertilization of plants.

Many species of both families are troubled by parasitic or cuckoo bees. These build no nest for themselves, but look out for a nest of the mason, carpenter, or other bee. When she discovers one at work, she watches, and as fast as the cells are completed, lays an egg at the bottom. This egg hatches before the egg of the rightful owner, and the larva of the intruder proceeds to eat the provisions stored by the careful mother of the rightful owner, and finally consummates its evil work by eating the young of the nest-builder.

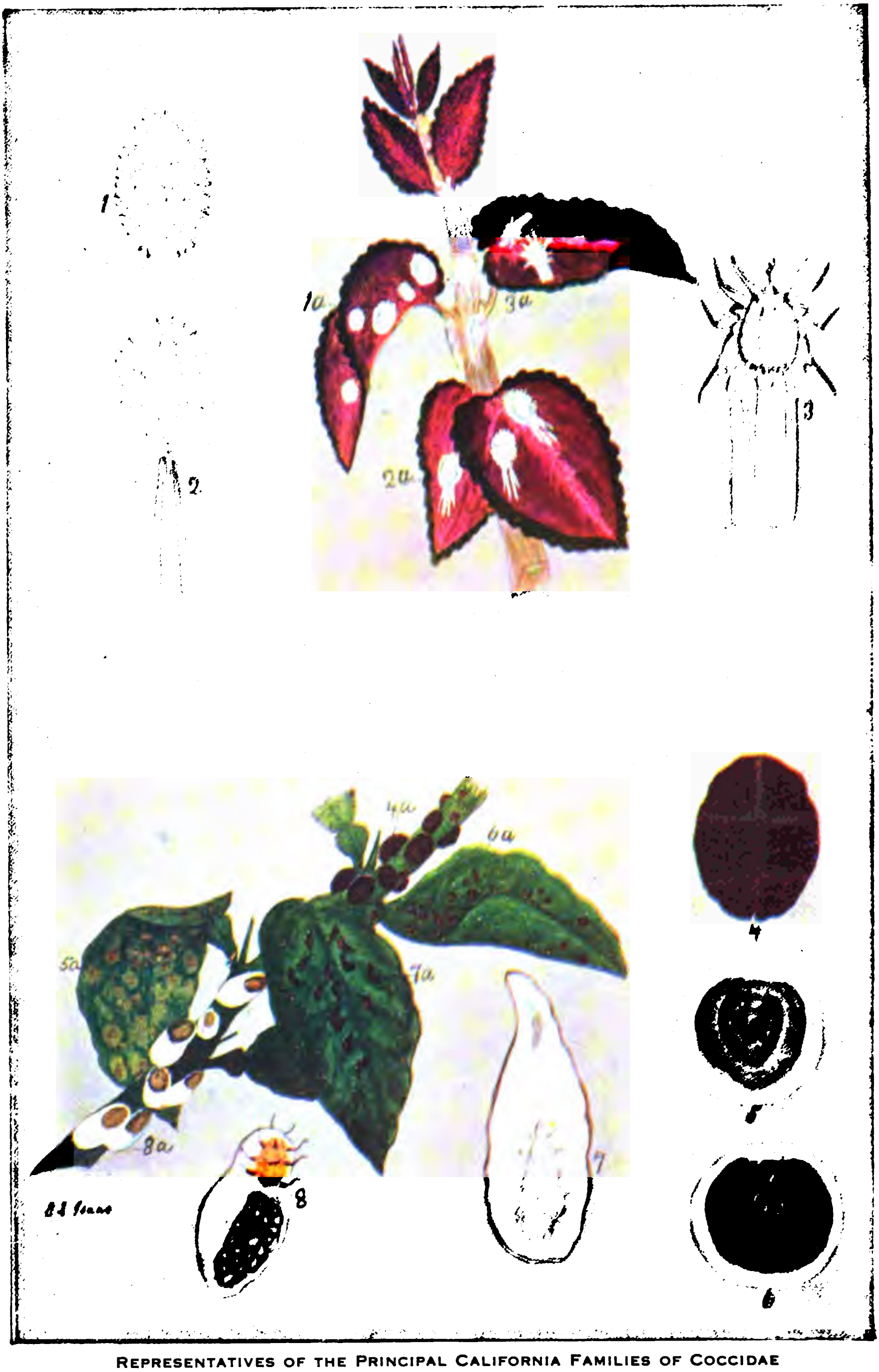
Of the social bees, including the honey-bee, little need be said here, as the subject is too great to be handled in a few pages, and our object is merely to draw attention to the science of entomology, not to enlarge upon it, and also to draw special attention to those families which are either directly beneficial or injurious to our orchards.

The foregoing will serve to give our readers some general idea of the important science of Entomology. As stated at the commencement, the work is not designed to be thorough in any respect, and pretends only to give an introduction to this great science. Those of our readers who wish to follow it to a greater extent are referred to the following works:

"Entomology for Beginners," by A. S. Packard; "American Insects," by Vernon L. Kellogg; "Manual for the Study of Insects," by John

Henry Comstock; "Economic Entomology," by John B. Smith; "The Insect Book," by L. O. Howard; "The Moth Book" and "The Butterfly Book," by W. J. Holland, and "Entomology, with Special Reference to its Biological and Economic Aspects," by Justus Watson Folsom.

Very many other excellent works on entomology might be recommended, but the above or any of them will be found valuable to the student of this science. In addition to these are the many excellent publications issued from time to time by the Federal Government, which can be secured by the student upon application.



REPRESENTATIVES OF THE PRINCIPAL CALIFORNIA FAMILIES OF COCCIDAE

PLATE II.

REPRESENTATIVES OF THE PRINCIPAL CALIFORNIA FAMILIES OF COCCIDÆ.

1. Mealy-bug (*Pseudococcus aurilanatus*), enlarged.

1*a*. Same, natural size, on coleus.

2. Mealy-bug (*Pseudococcus longispinus*), enlarged.

2*a*. Same, natural size, on coleus.

3. *Orthezia insignis*, enlarged.

3*a*. Same, natural size, on coleus.

4. Black scale (*Saissetia oleæ*), female, enlarged.

4*a*. Same, natural size, on orange.

5. Yellow scale (*Chrysomphalus aurantii citrinus*), ventral aspect of female, greatly enlarged.

5*a*. Same, slightly reduced, on orange leaf.

6. Red scale (*Chrysomphalus aurantii*), ventral aspect of female, greatly enlarged.

6*a*. Same, slightly reduced, on orange leaf.

7. Purple scale (*Lepidosaphes beckii*), ventral aspect of female, greatly enlarged.

7*a*. Same, slightly reduced, on orange leaf.

8. Cottony-cushion scale (*Icerya purchasi*), ventral aspect of female, greatly enlarged.

8*a*. Same, on orange twig, somewhat reduced,

THE COCCIDAE OF CALIFORNIA.

By EDWARD K. CARNES.

About sixteen years ago the State Board of Horticulture published a list of the Coccidæ (scale insects) of California, giving some twenty species found in the State. At that time comparatively little was known, by the residents of the State, about scale bugs or the amount of injury that could be caused by them; yet, to-day, there is no other single family of insects that is as important to the horticulturists of the world as are these minute creatures, and we can not know too much about them.

As a group they are very unattractive to the average entomologist, and even more so to the average horticulturist, yet a knowledge of the species and the best known methods of combating their attacks is a very essential part of the education of every successful fruit-grower. Fruit-growing is a competitive business, and the successful grower must avail himself of every opportunity to gain knowledge that will be of assistance to him in his business; therefore, it has been deemed advisable to bring before his notice the following list of species occurring in California, with illustrations and short descriptions of the more important varieties, in order to enable the grower to recognize and distinguish between the destructive species and those that are not so destructive. Since the first list was published, and especially during the last few years, there has been a very active period among the growers, orchardists, nurserymen, and those having greenhouse interests, to gain a knowledge of "scale insects." This activity has not been prompted by a love of the study of this particular branch of entomology, but purely as a business proposition, for these seemingly insignificant insects are capable of causing an enormous loss to the orchard, vineyard, nursery, or field in which they have gained a foothold. It must be remembered that each scale insect, after it has settled on the trunk, branch, or leaf of its particular host plant, virtually turns itself into an automatic pump and extracts the sap which is so vital to the life and growth of the tree. Usually the damage is done before the infestation is discovered, as many of our growers are absolutely without the slightest knowledge of scale insects. A tree, plant, or shrub will put forth every effort to sustain itself against the attack of the insect and will not show any immediate damage from the insects at work upon it, but even the strongest tree must ultimately yield to the persistent pumping of its life sap by the enormous number engaged in the work, and will suddenly collapse and die. This damage and loss might easily be overcome had the grower possessed a slight knowledge of the nature and work of scale insects, for remedial measures could have been applied at the first notice of their presence and their ravages stayed. It is partly with the idea of presenting this knowledge to the grower that the writer has deemed it advisable to publish the following list of 132 species which have been reported from this State, but of which list only 114 are actually found here. This list, with the illustrations and descriptions, it is hoped will enable the grower to recognize the destructive species and, with this knowledge at hand, avoid the danger and loss which their presence, unmolested, would eventually cause.

By personally collecting over the State, and with the kindly assistance of many residents of the State who are interested in the study of Coccidæ, and who have sent many specimens from various localities, the writer has been able to bring together the present authentic list.

The nomenclature of the "Coccidæ of the World," by Mrs. Fernald, has been followed in connection with the classification of the species. In this valuable work on Coccidæ, California has been credited as the habitat of several very destructive species which, in fact, are not to be found in the State, having been reported from quarantine only; other species are found only in greenhouses; and still others, the presence of which I have personally investigated, are to be found in California which are not given in the catalogue mentioned; these latter species I have added to the list of California Coccidæ. Undoubtedly additional species could be added to the list by closer investigation and collecting, as several new species are being prepared for publication, but which I am sorry to say will not be completed in time for this report. Additional species will be added to the list from year to year as they are discovered or described. The writer has only included the species known to exist in California at the present time.

For the descriptions and classification of the species mentioned the writer has freely consulted most of the leading entomological works on the subject of Coccidæ, and wishes to acknowledge the aid received from the efforts of the many able writers who have contributed to this subject; also, takes this opportunity to thank all those persons who have assisted in the work and made it possible to compile the present list.

While the primary object of this paper is to serve as a list for the benefit of fruit-growers, at the same time it is hoped that it may be useful to those students of Coccidæ who are making a study of the California forms. The scientific descriptions may not be of much benefit to the former class, yet they are indispensable to the latter in determining species, and have been added to encourage the study of this most important family. At the same time, the writer has endeavored

UNIV CALIF

to make the descriptions as plain as possible so that the average person can determine the different species with some degree of accuracy.

It must be remembered that when viewing one of the Diaspinæ externally, we are not looking at the real insect, but by carefully lifting up the shell-like covering the real culprit will be discovered underneath, as this covering only serves as a protection for the insect itself. Under the shell, the scale-bug appears as a legless, wingless, and almost shapeless form. For close study, by advanced students, it is removed from under the scale which covers it, and boiled in a solution of potash until colorless; it is then placed for about two hours in a water bath, and then mounted on a glass slide in glycerine jelly. The specimen is now ready for classification, and with the aid of a good compound microscope the distinguishing features can be easily recognized.

The descriptions of the more important species have been given, also reference has been made to others where the descriptions were not available. Illustrations of many of the species have also been added. Because of the fact that the amount of space which has been allotted to this paper is limited, the author has not been able to make it as complete as the importance of the subject demands; however, it is hoped that it will serve the purpose for which it is intended.

COCCIDAE OF CALIFORNIA.

(Scale Insects and Mealy-Bugs.)

Order **HEMIPTERA.** Family **COCCIDÆ.**

The following list of 132 species has been recorded, in the entomological literature of the world, as occurring in California. Those species included in this list designated by an asterisk (*) have been reported from quarantine and are not established in this State:

Subfamily **MONOPHLEBINÆ.**

SPECIES.	HOST PLANT.
Icerya purchasi crawii Ckll.	Orange, Lemon, Grape-fruit, Acacia, Pittosporum, Laburnum, Broom, Rose.
Icerya purchasi maskelli Ckll.	Food plants, same as above.

Subfamily **MARGARODINÆ.**

Xylococcus quercus Ehrh.	Quercus chrysolepis.

Subfamily **ORTHEZIINÆ.**

Orthezia insignis Dougl.	Coleus, Verbena, Chrysanthemum, Citrus, Tomato, Strawberry. (In greenhouse.)

Subfamily DACTYLOPIINÆ.

SPECIES.	HOST PLANT.
Asterolecanium quercicola Bouche	Oak.
Lecaniodiaspis rufescens Ckll.	Adenostoma oblongifolia.
Cerococcus ehrhorni Ckll.	Live Oak.
Cerococcus quercus Coms.	Oak.
Pollinia pollini Costa	Olive.
Kermes austini Ehrh.	Quercus oblongifolius.
Kermes cockerelli Ehrh.	Quercus lobata.
Kermes galliformis Riley	Oak.
Kermes nigropunctatus Ehrh., Ckll.	Oak.
Gossyparia spuria Modeer.	Elm.
Eriococcus adenostomæ Ehrh.	Adenostoma fasciculatum.
Eriococcus araucaria Mask.	Araucaria excelsa, A. bidwillii.
Eriococcus artemisiæ Kuw.	Artemisia.
Eriococcus palmeri var. *A.* Ckll.	Eriogonum fasciculatum.
Dactylopius coccus Costa.	Cactus sp.
Sphærococcus disticlium Kuw	Distichlis maritima.
Phenacoccus artemisiæ Ehrh.	Artemisia californica.
Phenacoccus simplex King.	Atriplex.
Phenacoccus stachyos Ehrh.	Stachyos bullata.
Phenacoccus kuwanæ Col.	Lichen on Picea breweriana.
Ceroputo bahiæ Ehrh.	Bahia.
Ceroputo yuccæ Coq.	Yucca sp.
Ceroputo yuccæ ceanothi Ckll.	Ceanothus oliganthus.
Pseudococcus aurilanatus Mask.	Araucaria bidwillii.
Pseudococcus azaleæ Tins.	Azalea. (In Japanese nursery.)
Pseudococcus calceolariæ Mask.	New Zealand Flax.
Pseudococcus citri Risso	Orange, Lemon, Ivy, Coleus, Croton, [etc.
Pseudococcus crawii Coq.	Sagebrush.
Pseudococcus ephedræ Coq.	Ephedra californica.
**Pseudococcus iceryoides* Mask.	Fagus fusca.
Pseudococcus longispinus Targ.	Fern, Croton, Cycas revoluta, and many other plants.
Pseudococcus maritimus Ehrh.	Eriogonum latifolium.
Pseudococcus pseudonipæ Ckll.	Cocoanut Palm. (In greenhouse.)
Pseudococcus quercus Ehrh.	Quercus chrysolepis.
Pseudococcus ryani Coq.	Cupressus macrocarpa.
Pseudococcus salinus Ckll.	Grass.
Pseudococcus sequoiæ Col.	Redwood.
Pseudococcus andersoni Col.	Cupressus goveniana, Libocedrus [decurrens.
Pseudococcus dudleyi Col.	Cupressus macnabiana.
Erium eriogoni Ehrh.	Roots of Eriogonum.
Ripersiella kelloggi Ehrh., Ckll.	Roots of Bunch-grass.

SPECIES.	HOST PLANT.
Ripersia festucæ Kuw.	Festuca scabrella.
Ripersia villosa Ehrh.	Quercus agrifolia.
Antonina crawi Ckll.	Bamboo.
Subfamily **COCCINÆ.**	
Pulvinaria bigeloviæ Ckll.	Bigelovia.
Pulvinaria camelicola Sign	Camellia. (In greenhouse.)
Pulvinaria ehrhorni King	Willow, Alder.
Pulvinaria innumerabilis Rathv.	Apple, Pear, Grape, Willow, etc.
Pulvinaria psidii Mask.	Fern, Pittosporum. (In gr'nhouse.)
Pulvinaria rhois Ehrh.	Rhois diversiloba.
Exæretopus caricis Ehrh.	Carex breweri, Trisetum subspicatum.
Ceroplastes ceriferus Anderson	Camellia. (In greenhouse.)
Ceroplastes cistudiformis Town, Ckll.	Pepper-tree.
Ceroplastes cirripediformis Comst.	Pepper-tree.
**Ceroplastes floridensis* Comst.	Citrus, Mango, Anthurium.
Ceroplastes irregularis Ckll.	Atriplex sp.
Vinsonia stellifera West.	Orchids, Ferns, Cocoanut Palms. (Orchid in greenhouse.)
Eucalymanatus perforatus News.	Kentia Palms. (In greenhouse.)
Coccus hesperidum Linn.	Orange, Lemon, Grape-fruit, Oleander, Ivy, Maple, Laurel, etc.
Coccus ventralis Ehrh.	Tuberous plants. (In Japanese Nursery.)
Eulecanium adenostomæ Kuw.	Adenostoma fasciculatum.
Eulecanium armeniacum Craw.	Apricot, Peach, Plum, Pear, Prune, Cherry, Grape, etc.
Eulecanium cerasorum Ckll.	English Walnut, Pear.
Eulecanium crawii Ehrh.	Acer macrophyllum.
Eulecanium magnoliarum Ckll.	Virginia Creeper, Grape.
Eulecanium pruinosum Coq.	Prune, Apricot, Peach, Plum, Hawthorn, Rose, Apple.
Eulecanium pubescens Ehrh.	Oak.
Eulecanium quercitronis kermoides Tyr.	Oak.
Eulecanium tulipiferæ Cook	Cherry.
Saissetia filicum Bdv.	Ferns.
Saissetia hemisphærica Targ.	Orange, Cycas revoluta, Ferns.
Saissetia hemisphærica hibernaculorum Bdv.	Ferns, and various hothouse plants.
Saissetia nigra Nietn.	Palms. (In greenhouse.)

Species.	Host Plant.
Saissetia oleæ Bern.	Olive, Orange, Lemon, Grape-fruit, Peach, Prune, Plum, Apricot, Apple, Pear, Pomegranate, Oleander, Rose, Pittosporum, and many other plants and shrubs.
Physokermes insignicola Craw	Pinus insignis.
Physokermes concolor Col.	Abies concolor.
Physokermes taxifoliæ Col.	Pseudotsuga taxifolia.
Aclerda californica Ehrh.	Andropogon furcatus.
Aclerda tokionis Ckll.	Bamboo.
Subfamily **DIASPINÆ.**	
**Chionaspis citri* Comst.	Orange.
**Chionaspis difficilis* Ckll.	Elæagnus.
Chionaspis ortholobis Comst.	Willow.
Chionaspis pinifoliæ Fitch	Pine and other coniferous trees.
Chionaspis quercus Comst.	Oak.
Chionaspis salicis-nigræ Walsh	Willow, Ceanothus.
**Chionaspis wistariæ* Cooley	Wistaria. (From Japan.)
**Howardia biclavis* Comst.	Orange.
Diaspis bromeliæ Kuw.	Pineapple.
Diaspis carueli Targ.	Juniper, Cupressus.
Diaspis cattleyæ Ckll.	Cattleya.
**Aulacaspis crawii* Ckll.	Elæagnus umbellata.
**Aulacaspis pentagona* Targ.	Flowering Peach, Plum, Sago-palm.
**Aulacaspis pentagona auranticolor* Ckll.	Osmanthus illicifolia. (From Japan.)
Aulacaspis rosæ Bouche	Rose, Blackberry, Raspberry. (Infesting the canes.)
**Phenacaspis aucubæ* Cooley	Aucuba. (From Japan.)
**Phenacaspis chinensis* Ckll.	Quercus. (From China.)
**Phenacaspis cockerelli* Cooley	Palm. (From China).
**Phenacaspis latissima* Ckll.	Distylium racemosum. (From Japan.)
Hemichionaspis aspidistræ Sign.	Aspidistar lurida.
**Leucaspis japonica* Ckll.	Broom, Maple, Peonia. (From Japan.)
Leucaspis cupressi Col.	Cupressus goveniana.
Leucaspis kelloggi Col.	Pseudotsuga taxifolia, Abies magnifica.
Fiorinia fioriniæ Targ.	Cocoanut-palm, Camellia, Ferns, Ficus sp.
Epidiaspis piricola Del Guer.	Pear, Plum, Apple, Peach.
Aspidiotus æsculi Johns.	Æsculus californica.
Aspidiotus hederæ Vall.	Oleander, Ivy, Lemon, Asparagus, Fern, Cycas revoluta, Palms, Orchids, Camellia.

SPECIES.	HOST PLANT.
Aspidiotus juglans-regiæ Comst.	English walnut.
*_Aspidiotus ostreæformis_ Curt.	Pear, Apple.
*_Aspidiotus perniciosus_ Comst.	Apple, Pear, Peach, Quince, Apricot, Plum, Hawthorn, Rose, Currant, Raspberry, etc.
*_Aspidiotus perniciosus albopunctatus_ Ckll.	Orange, Plum. (From Japan.)
Aspidiotus rapax Comst.	Willow, Holly, Ivy, Acacia, Orange, Pittosporum, Camellia, Palms, Ferns, etc.
Aspidiotus californicus Col.	Pinus sabiniana, P. ponderosa, P. lambertiana, P. attenuata.
Aspidiotus coniferarum shastæ Col.	Cupressus macnabiana.
Aspidiotus ehrhorni Col.	Under lichens on Abies concolor, Libocedrus decurrens.
Aspidiotus florenciæ Col.	Pinus ponderosa.
Pseudaonidia duplex Ckll.	Camellia. (In Japanese nursery.)
*_Pseudaonidia pæonia_ Ckll.	Peony. (From Japan.)
Chrysomphalus aonidum Linn.	Palms. (In greenhouse.)
Chrysomphalus aurantii Mask.	Orange, Lemon, Grape-fruit, Rose, Cycas revoluta, and species of Palms.
Chrysomphalus aurantii citrinus Coq.	Orange, Oleander, Palms.
Chrysomphalus tenebricosus Comst.	Maple, Apple.
Targionia bigeloviæ Ckll.	Bigelovia brachylepis.
*_Odonaspis bambusarum_ Ckll.	Bamboo. (From Japan.)
Lepidosaphes beckii Newm.	Orange, Lemon, Grape-fruit, Palms.
Lepidosaphes crawii Ckll.	Quercus cuspidatus.
Lepidosaphes gloverii Pack.	Orange.
Lepidosaphes ulmi Linn.	Apple, Pear, Plum, Willow.
Parlatoria pergandii Comst.	Orange.

DESCRIPTION OF THE MORE IMPORTANT SPECIES, WITH NOTES.

Accompanying the descriptions of the more important species in the following pages will be found a number of illustrations, which will give the reader a fair idea of the general appearance of the different forms of scale insects, as well as a colored plate showing members of each of the principal subfamilies represented in California.

For the convenience of the County Horticultural Commissioners and Inspectors, as well as of others interested in this study, a number of plates have been added, showing original drawings of the last abdominal segments of many of our more important species. In the study of scale insects, especially those members of the subfamily Diaspinæ, in order to make final determination of the species the first requisite is a good microscope. The last abdominal segment of the adult female presents peculiar organs, designated by distinct names. These terms must be recognized by their various names in order to accurately determine any given species from the technical description. A glossary of the scientific terms used in the descriptions of the Coccidæ is presented herewith. On Plate III will be found an illustration of the last abdominal segment of an adult female Diaspinæ, showing the form and position of the terms used. By careful study of this figure, aided by the glossary, the technical descriptions will lose their mystification to the beginner, and after a little practice any intelligent person, aided by the microscope, will be able to identify species with some degree of accuracy.

When the determination of a scale insect is wanted, first observe the name of the host plant upon which it is found, then turn to the list of species and note what scales are found upon that particular plant in California. In case there are several species, note the general description of the scale in hand and compare it with the illustrations, and, in many cases, the determination may be made from this alone. If this is not sufficient, read the description of the female, and in this case the final determination calls for the use of the microscope. By following the description and referring to Plate III the various organs used in the determination of the species will be seen and made clear. The descriptions have been systematically arranged according to subfamily and genus.

GLOSSARY OF TERMS USED IN DESCRIPTIONS.

Abdomen. All the hinder part of the insect, the third of the three main divisions of the body (head, thorax, and abdomen).

Anal Lobes; Anal Plates. A small pair of triangular processes forming a valve which covers the anal orifice.

Anal Orifice. The external opening of the intestine.

Anal Ring. A circumscribed ring encircling the anal orifice.

Anal Tubercles. A pair of prominent rounded processes on each side of the anal orifice.

Antennæ. A pair of jointed organs or feelers situated on the head.

Appendages. General term for antennæ, mouth parts, and legs of an insect.

Bicuspid. Having two points.

Carina. A keel or ridge.

Carinated. Keeled, ridged, or ribbed.

Castaneous. Shiny, reddish brown.

Caudad. Situated toward the tail.

Cephalic. Pertaining to the head.

Cephalothorax. The anterior part of the body, comprising the head and thorax.

Chitinous. Consisting of a horny substance present in the skin and harder parts of insects.

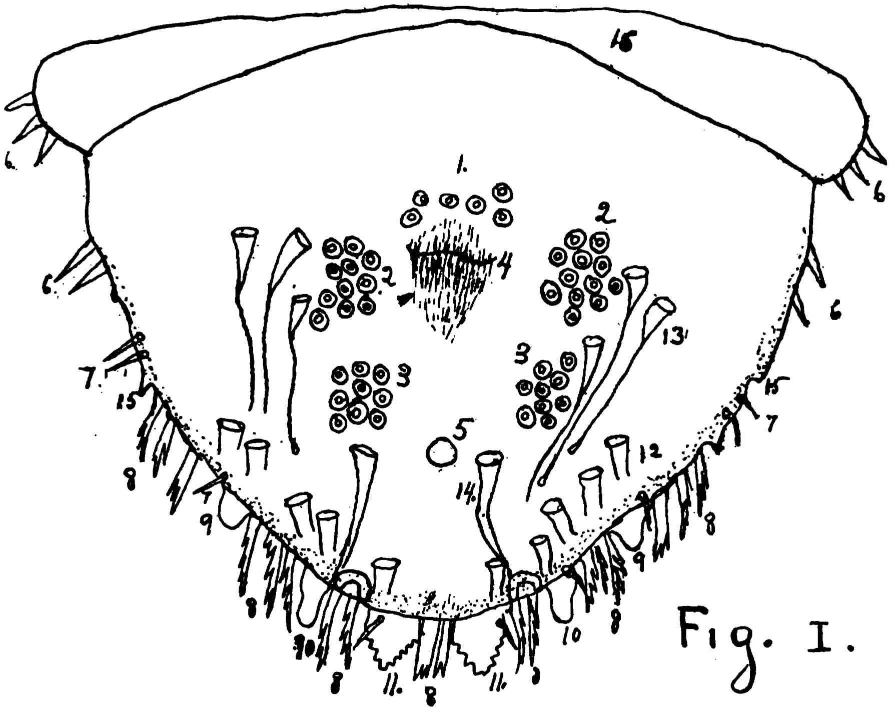


FIG. 1. Pygidium of Female Diaspinæ.

Circumgenital glands or spinnerets (in groups 1, 2, 3).

1. Median group.
2. Upper laterals.
3. Lower laterals.
4. Genital aperture.
5. Anal aperture.
6. Spine-like plates.
7. Spines.
8. Fumbriated plates.
9. Third pair lobes.
10. Second pair lobes.
11. First or median pair lobes—serrate.
12. Tubular spinnerets.
13. Trumpet-shaped filiform spinnerets.
14. Trumpet-shaped tubular spinnerets.
15. Marginal prominence.
16. Abdominal segment.

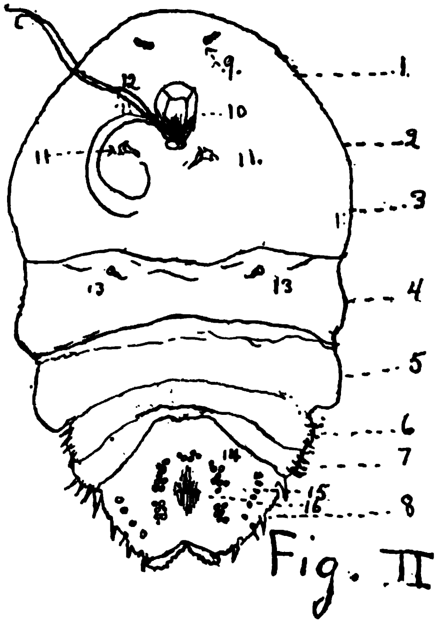


FIG. 2. Body of Female Diaspinæ.

1. Head.
2. Prothorax.
3. Mesothorax.
4. Metathorax.
5, 6, 7. Abdominal segments.
8. Pygidium.
9. Antennæ.
10. Rostrum.
11. Anterior spiracles.
12. Rostral setæ.
13. Posterior spiracles.
14. Spinnerets or circumgenital glands.
15. Genital aperture.
16. Pores of tubular spinnerets.

C. T. P., del.

VENTRAL SURFACE OF SCALE INSECT; SHOWING VARIOUS ORGANS.

Circumgenital Glands. Small circular glands in distinct groups around the genital orifice.

Coxa. The basal joint of the leg.

Depressed. Flattened from above downward.

Digitules. Appendages frequently present on the feet of Coccidæ.

Dorsal. Relating to the back or upper parts of the body.

Dorsal Scale. The part of the covering scale that lies above the scale proper and the part seen when viewing a scale externally; between this and the ventral scale is found the female.

Dorsum. The back or upper part of the body.

Exuviæ. The discarded skins shed at the periodical molts.

Femur. The thigh or upper part of the leg.

Filiform. Thread-like.

Honey-dew. A sweet, sticky substance exuded by the Coccidæ and other insects.

Incised. With marginal slits or notches.

Laterad. Toward the side.

Larva. The immature insect.

Lobe. Any prominent rounded process. (See illustrated plate.)

Mesad. Situated toward the middle.

Mesal. Relating to the middle.

Metamorphosis. The transformations of an insect during its development.

Ocelli. The simple or supplementary eyes.

Oviparous. Producing eggs.

Ovoviviparous. Producing eggs which are hatched within the body of the parent.

Parasitized. Containing parasites.

Pellicles. The "exuviæ" or cast larval skins.

Plate. Any broad, flattened piece.

Processes. Any prominent portions of the body not otherwise definable.

Pupa. The chrysalis or resting stage of an insect.

Pygidium. The compound terminal segment of the body. (See illustrated plate.)

Rostral Setæ. The four long, hair-like processes which together form the sucking tube.

Secretion. Matter produced by the various glands of the body, more particularly the cottony, waxy, silken substances of which the coverings of many scale bugs are composed.

Segments. The transverse divisions of the body.

Serrated. With margin notched like a saw.

Seta. A stout hair or bristle.

Spiracles. The respiratory organs.

Tarsus. The terminal joints of the legs.

Thorax. The second or main division of the body; that part which bears the legs and wings when present.

Tibia. The single joint of the leg immediately succeeding the "femur" and preceding the "tarsus."

Truncate. With end having appearance of being abruptly cut off.

Ventral. Relating to the under surface of the body.

Ventral Scale. The under part of the covering scale, between the insect and the plant.

Subfamily **MONOPHLEBINÆ.**

Icerya purchasi crawii Ckll.

Female (after forming ovisac).—Light pinkish or yellowish red; the margin orange, with bunches of short black bristles; the back is largely covered with yellowish-white secretion. Ovisac somewhat larger and longer than *maskelli*; femora decidedly more slender.

On orange, lemon, grape-fruit, acacia, pittosporum, broom, rose.

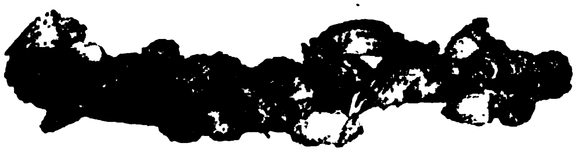


FIG. 1. *Icerya purchasi crawii.* Females on orange twig.

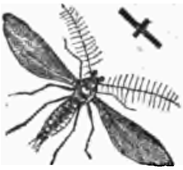


FIG. 2. Male of *Icerya purchasi crawii.*

Icerya purchasi maskelli Ckll.

Female (after forming ovisac).—Slate gray or very dark purplish gray, sometimes brownish in the middle, with marginal dull orange spots. Back little covered by secretion. More hairy at the cephalic end than *crawii.* Ovisac not so large as in *crawii*, tinged with yellow just behind the body of the insect. It is *purchasi* in the strict sense and agrees very nearly, though not entirely, with Maskell's description.

Food plants: same as *I. crawii.*

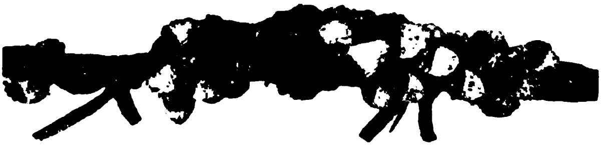


FIG. 3. *Icerya purchasi maskelli.* Females on orange twig.

The two species above mentioned are well known to almost every resident of California, and are commonly known as the cottony-cushion scale, the white scale, or the fluted scale. Until the introduction of their natural insect enemy (*Novius* [*Vedalia*] *cardinalis*) this pest engaged the attention of our citrus-growers more than any one thing, but within a few short months after its introduction, *N. cardinalis* had the pest practically controlled and has held it so for many years. To-day it is hard work to find enough of the scale to keep the breeding cases in our Insectary supplied with food. The two species mentioned are usually associated with each other on the same tree. They may be distinguished in the adult stage, however, as one is a light form and the other dark.

Subfamily **MARGARODINÆ.**

Xylococcus quercus Ehrh.

The specimen taken in October is very dark in color, blackish, the markings being only faintly indicated.

Egg quite large, of a light orange color.

Young larvæ dark orange-red, active, body broadly oval, about ⅔ mm. long. Legs and antennæ light brown, well developed. Antennæ short, 6-jointed. Joint 1 stoutest, joint 6 longest, and joint 4 shortest. Formula: 6 5 1 2 3 4. Joints 2 and 5 with three bristles. Joint 6 with numerous long stout bristles. Legs moderately long, with femur quite swollen. Tarsus longer than tibia. Digitules of tarsus fine hairs; those of claw long stout clubs curved upward. Each segment of abdomen bears a backward-directed short stout spine. On each side of anal tube is a long fine bristle. Anal tube large, with numerous stout spines. Stigmatal tubes well developed.

Female (second stage).—Body crimson, shiny, nearly spherical, about 1½ mm. long, 1 mm. broad, surrounded by cottony and waxy secretion. Antennæ and legs wanting. Anal tube well developed, producing a glassy rod, like a stout white hair, rather brittle. Last segment of body dark brown. When cleared in KHO, surface of body finely granulated, more so near caudal end. Stigmatal tubes are large and well defined. There are numerous spines and gland openings scattered over the body.

Third and fourth stages very similar to second stage, but larger in each case than the preceding, and varying in the further development of stigmatal and anal tubes, glands, spines, etc.

Adult Female.—Head, thorax, legs, and antennæ reddish brown, abdomen blackish brown, segmentation distinct. There is a distinct constriction between the thorax and abdomen. Length of body about 5½ mm., breadth 2½ mm., quite convex above. Ventral side of abdomen concave, with revolute margins. Insect quite active. When ready to deposit eggs crawls into some crevice and produces a cottony cushion, on which it rests and secretes considerable white cotton over its entire body. Antennæ 9-jointed. Joint 1 longest and broadest, next in length is 2, then joint 9, and then 3. Joints 4, 5, 6, 7, and 8 are subequal, and are a little shorter than 3. Formula: 1 2 9 3 (4 5 6 7 8). Legs long and stout. Tibia twice as long as tarsus, both very hairy. Claw long and stout. Digitules fine hairs. Body sparsely covered with long stout spines, especially along the margin and caudal end. Stigmatal tubes very prominent. Anal opening simple and quite large.

Adult Male.—About 3 mm. long and 1½ mm. broad, slightly pubescent. Color of abdomen reddish brown. Mesothorax black, with four raised knobs. Front part of head black, eyes very prominent, strongly faceted, black. Legs and antennæ black and very hairy. Ventral surface of abdomen dark brown, segmentation distinct. Mesosternum black, a small black line on poststernum, and an irregular black patch on metasternum. Abdominal brushes with long stout glassy bristles about 6 mm· long. Style short, stout, and conical. Antennæ 10-jointed, very hairy, reaching beyond end of abdomen. Joint 2 shortest, joints 3 and 10 a little longer, and the other joints subequal. Each joint with numerous hairs. Wings large, about 3 mm. long and 1 mm. broad, expanse about 7 mm.; smoky, slightly pubescent, with a costal space blackish brown, halteres resembling small wings with several hooks. Legs long, stout, and very hairy. Femur much shorter than tibia. Tibia about four times as long as tarsus. Digitules fine hairs. Claw long, slender, and well curved. Digitules short clubbed-shaped hairs.

On *Quercus chrysolepis*.

This wonderful insect is of little economic importance and requires close inspection to detect its presence. A long white, thread-like protuberance is first noticeable coming out of the cracks of the bark on the oak while the female is buried underneath.

Subfamily **ORTHEZIINÆ.**

Orthezia insignis Dougl.

(Colored Plate II.)

Adult Female.—Body broad oval; width, 1.2 mm.; length, 1.5 mm., exclusive of lamellæ; ochreous, mottled to dark green; distinctly segmented. Arranged around the body, beginning with the second thoracic segment, are white, waxy plates or lamellæ. In the adult female the lamellæ are united posteriorly, forming a long, parallel-sided marsupium, which contains the eggs and young. The arrangement of the lamellæ can be better shown by a figure (See colored Plate II) than by a description. Antennæ 8-jointed, all fulvous except the black, somewhat fusoid eighth joint; the first joint is very stout, the second the stoutest and shorter than the remaining ones. Legs light brown, the darker tarsi bearing numerous fine spines.

Adult Male.—The slender, dusky body is about 1 mm. in length, and bears two large ovate, transparent wings with two veins united at the base. Wing expanse, 2.5 mm. The last segment bears on each side a long, white filament.

This insect is strictly a greenhouse species, and sometimes is very destructive to coleus, verbena, and chrysanthemum.

Subfamily **DACTYLOPIINÆ.**

Pollinia pollini Costa.

This scale was introduced in 1887 from Italy on a shipment of olive trees, but its presence was not noticed until 1893, when the trees were destroyed and a careful search made for any other infestation. None has been noticed since that time, although a careful inspection has been made many times since, and it is reasonable to suppose that it was eradicated.

Kermes austini Ehrh.

Female Scale.—Spherical, about 4.5 mm. broad, 4 mm. long, 4 mm. high. Dorsum slightly covered with a waxy secretion. Scale not gibbous and segmentations indistinct, indicated by brown dots when seen through a lens. Color light brown, with several irregular white stripes running parallel with the segments. There is a distinct groove on the caudal portion of the scale, which is distinctly marked with brown. Scale more or less pitted; pits generally marked dark brown or black. Ventral scale is more or less flat and light brown. Keel not very prominent. When boiled in KHO derm is light brown, with several brown spots and numerous round gland-orifices, which are larger near the margin. A few short spines near the margin. Antennæ very short and stout, indistinctly 6-jointed. Joint 3 longest, 4 and 5 subequal.

Larva (taken from body of female).—Color pink, twice as long as broad; after boiling in potash, colorless. Antennæ and legs yellow. Antennæ 6-jointed. Formula: 3 6 (2 5) (4 1). Caudal tubercles large, with very long setæ and three stout spines—one at base of tubercle, one on its inner margin, and one near setæ. On the margin of body each segment has a stout spine. Legs stout. Tarsus not twice as long as tibia. Femur nearly twice as long as tarsus plus tibia. Claw slender and curved.

On twigs of *Quercus oblongifolius.*

Many specimens of this species are found to be parasitized.

Kermes cockerelli Ehrh.

Female.—Scale 5 mm. long, 4.5 mm. broad, and 4 mm. high, deeply segmented, dorsum usually marked with black lines and spots along the sutures, some specimens not showing any. There is a broad, median, longitudinal groove, where the segmentation is obsolete; on each side of this the segments are strongly gibbous. Color light brown, without any conspicuous black specks; derm, by transmitted light, brown with numerous oval glands, several large postulæ on body. Antennæ very small, 6-jointed; joint 3 very large, longer than the three following together; the others short, very little longer than 5, 4 shortest.

Larva elongated oval, rather more than twice as long as broad, yellow, greatest breadth behind the middle of body. Eyes red, caudal tubercles quite large, each bearing one long bristle and three stout spines, one near bristle and one on the outer and inner margins of tubercle. On the anterior margin of the head are six bristles; the sides of the abdominal segments are armed with stout, but not very long bristles. Antennæ cylindrical, 6-jointed; formula: (3 6) (1 2) 4 5; last joint rounded at tip with several hairs, one very long; rostral loop extending halfway between base of third pair of legs and anal ring. Legs quite large, claw long and curved; tibia shorter than tarsus.

On twigs of *Quercus lobata*.

Very much parasitized by undetermined chalcid.

Kermes galliformis Riley.

The following short description of this species is taken from Mr. King's article "The Genus Kermes in North America," and the description published in "Coccidæ of Ohio," by James G. Saunders:

"A large dirty-gray form, which turns to a nearly white color when exposed to a season on the twigs. Female scale 6 mm. long, 7 mm. broad, 6 mm. high, with black spots, and viewed with a hand lens the scale is seen to be covered with minute black specks. Newly hatched larva dirty gray."

On oak.

Kermes nigropunctatus Ehrh. and Ckll.

Female.—Scale 4.5 mm. long, 5.5 mm. broad, nearly 4 mm. high, not very pale ochreous, speckled all over with black, the black specks so small as to be readily overlooked without the use of a lens; segmentation obscure, but discernible, the sutures slightly impressed and marked by more or less pallid transverse bands; an obscure median longitudinal depressed line; under side of scale, where it touches the bark, flattened and entirely dark brown; derm by transmitted light yellow, with numerous round glands. Antennæ small, 6-jointed; joint 3 very long, about as long as 4, 5 and 6 together; joints 2 and 4 subequal and smallest. Formula: 3 1 6 5 (2 4).

Larva oval, about one and a half times longer than broad; greatest breadth about the middle; pink; caudal tubercles large and distinct, each bearing a moderately long bristle and three stout spines, one on the outer and inner margins and one near bristle. The sides of the abdominal segments are armed with stout, short bristles. Antennæ cylindrical, 6-jointed, formula 3 6 1 (4 5) 2; last joint rounded at tip with several hairs; joint 5 with a hair; rostral loop extending beyond third pair of legs; anal ring with six hairs. Legs stout, claw long and curved; tibia much shorter than tarsus.

The larvæ were found in body of female. It is something like *K. galliformis*, but distinguished by the impressed sutures.

On twigs of *Quercus*.

The four species of *Kermes* above mentioned are of little importance, although occasionally a tree may be found which will contain quite a few specimens of the scale, but in most cases they are heavily parasitized and are thus held in check and not allowed to increase to any extent.

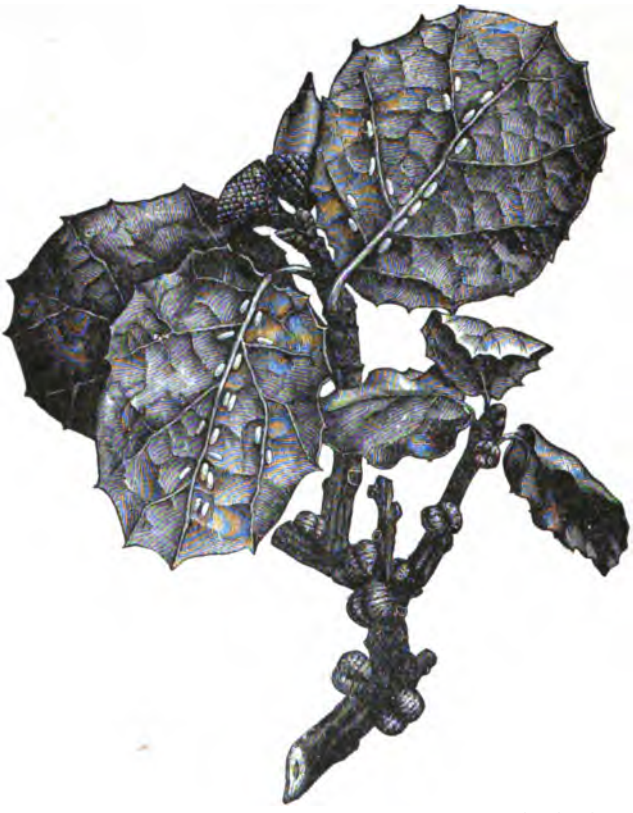


FIG. 4. *Kermes nigropunctatus.* Larvæ and adults on twig of oak.

Gossyparia spuria Modeer.

(Elm-tree Scale.)

Larva.—The newly hatched larva is of an elongated oval form, narrower behind, of a clear yellow color, each segment with a strong lateral spine, and the front border of the body with six spines. The genito-anal ring has six hairs, around which is later formed a secretion, which renders them invisible. There is a double row of spines down the middle of the back; the antennæ are 6-jointed, joints 2 and 3 longest, 4 and 5 shortest. There is an elongated protuberance each side of the antennæ. The legs are short and slender, with the tibia shorter than the tarsus. The genito-anal ring has eight hairs.

The full-grown male larva has 7-jointed antennæ, joint 7 longest, the rest equal. After impregnation the female becomes more round, fixes herself, the secretion becomes much more abundant on the sides, making at first lamellæ, which afterwards unite into a cushion. The back becomes smooth and the segmentation becomes plainly visible. The dorsum is plane transversely, but curved longitudinally. Particularly after the birth of the young, the female becomes well separated from the waxy cushion, and is easily removed from it (even jarring will accomplish the removal), leaving the noticeably empty white cup with its fringed edges.

Dr. L. O. Howard gives the following description:

Male.—"The antennæ of the male are 10-jointed, the joints well separated. The wings are represented by pads of varying length. The poisers appear rather thick and fleshy, but lack the terminal hook. The abdomen is very stout, suboval, considerably broader than the thorax, and when seen from above covers coxæ, trochanters, and base of the femora. Its segments are not well marked. A few days after this form makes its appearance the cocoons begin to give out the perfect males, which issue with wings fully expanded. There seems to have been a molt between this pseudimago and the perfect males, for in no other way can we account for the difference in form. The antennæ possess the same number of joints (10), of about the same relative proportion, although joints 3 and 4 are longer, but the incisures are rather better marked. The poisers are lighter in color, and less fleshy in appearance, and the curved hook is plainly visible at tip. The abdomen is rather longer, much more slender, and tapers gradually from base to tip. Its segments are well incised and plainly separable from above. It does not cover the hind coxæ and trochanters. The tibiæ are longer in proportion to their tarsi. The anal segment gives off two waxy filaments as long as the entire body. These filaments were not noticeable in the pseudimago."

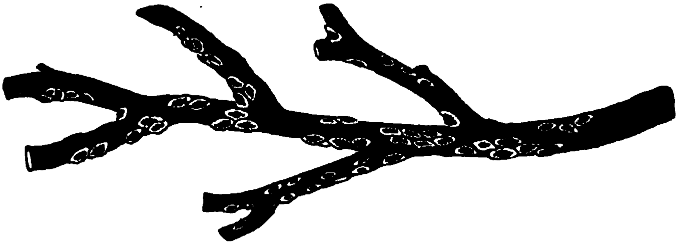


FIG. 5. *Gossyparia spuria.* On elm.

The cocoon of the male is rather close, though thin, flattened oval, and pure white, about 2 mm. long by 1 mm. wide, and is composed of rather coarse waxy fibers.

On elm trees.

We have but one generation of the scale a year in California. The young are brought forth alive during May, locate on the leaves and later settle on the branches.

In other states this species has proven a very destructive pest to the elms. In one locality in California it gained quite a foothold, but prompt remedial measures were applied and the scale has not been allowed to increase, although scattering specimens may be found on some of the trees originally infested.

Eriococcus araucaria Mask.

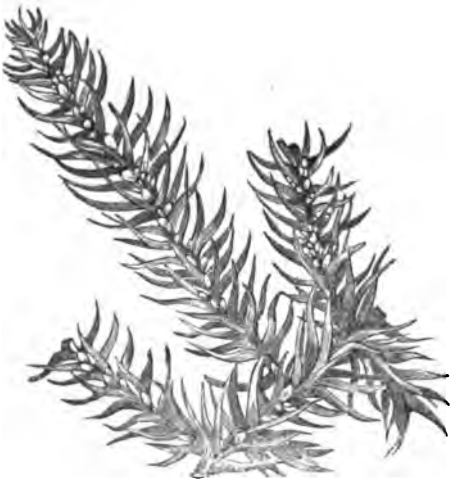


FIG. 6. *Eriococcus araucaria.* On Araucaria bidwillii.

The presence of the black fungus which accompanies many species of coccids, usually first denotes the presence of this scale. The full-grown insects are contained in white cocoon-like sacks, which are often massed toward the ends of the twigs. The larvæ are inconspicuous and are found in the angles formed by the bases of the leaves. Both sexes are similar in the larval form. They are greenish yellow in color; the posterior end of the body is furnished with two prominent lobes, each terminated by a long hair. Between these lobes there is a conical mass of white waxy matter projecting backward. The margin of the body is fringed with a row of tubular spinnerets. The female when full grown measures 2.3 mm. in length. When the female is ready to lay her eggs, she excretes a cocoon-like covering to the body, composed of white waxen threads. This sac is dense, like felt, but easily torn, and appears to be open on the middle line of the ventral surface. It adheres to the tree quite firmly, remaining where excreted after the death of the insect.

On *Araucaria excelsa*, *A. bidwillii.*

Eriococcus adenostomæ Ehrh.

Female.—Inclosed in an oval (at one end more or less pointed) sac about 3 mm. long and 1½ mm. broad, woolly, snow-white, of uniform texture. Oval, about half again as long as broad, dark purple, turning bright crimson when placed in KHO. Body about 1½ mm. long. Antennæ light brown, 7-jointed; formula, approximately: (3 4 7) (1 2) 5 6; joint 3 equal to 5 and 6. Most of the joints with hairs; joint 7 with several comparatively long hairs. Legs light brown, large and stout; each joint with one or more bristles; femur quite swollen; tarsus a trifle longer than tibia. Claw stout and curved. Both tarsus and claw with long filiform digitules. Posterior tubercles short and rounded, with one very long, stout bristle and two shorter ones on their outer margin. Anal ring large, with eight long bristles. Derm colorless, with quantities of small spines and rounded glands distributed all over the dorsum.

Sac of male smaller and narrower than that of the female, color more creamy.

On *Adenostoma fasciculatum.*

Phenacoccus artemisiæ Ehrh.

Adult Female.—Elongate oval, about 3 mm. long and 1½ mm. broad, of a sage-green color; measuring with egg sac 4½ mm. Sac loosely woven without any grooves, eggs lemon-yellow. Legs and antennæ light brown. Body thinly covered with secretion, but not enough to hide color of body. Segmentation distinct. When placed in boiling KHO, body turns orange color, and leaves derm colorless after boiling. Antennæ 9-jointed; joint 2 always longest, joints 5, 6, 7, 8 subequal. Formula: 2 3 9 1 4 (5 6 7 8). Joints 1, 7, 8, and 9 with several stout hairs. Legs short and stout; femur about as long as tibia; tibia twice as long as tarsus. Claw stout and long, with tooth. Digitules fine knobbed hairs.

Adult Male.—Abdomen yellowish green, thorax and head dark green. Thorax marked with black longitudinal lines. Body slightly pruinose. Antennæ and legs light brown. Eyes dark red. Wings more or less pruinose, very delicate. Antennæ very hairy, 10-jointed; joint 3 longest, joint 1 shortest and stoutest, joints 7, 8, and 10 subequal, joints 2 and 9 subequal. Formula: 3 4 5 6 (7 8 10) (2 9) 1. Legs very hairy, long and slender; tibia much longer than femur; tarsus very short, less than one third of tibia. Claw long and very slender. Digitules fine hairs.

On *Artemisia californica.*

Phenacoccus stachyos Ehrh.

Adult Female.—About 2½ mm. long and 1 mm. broad, convex, tapering posteriorly, viviparous, of a sage-green color. Slightly covered with white secretion, which, when seen through lens, appears as minute white dots. Segmentation distinct. There are two longitudinal rows of light brown dots on the meson. The dorsum and margin are thickly set with long fine iridescent spines, which are deciduous. Legs and antennæ light brown, quite hairy. Caudal filaments short and stout. When placed in boiling KHO, body turns reddish brown. After boiling, derm becomes colorless, antennæ, mouth parts, and legs remaining light brown. Antennæ long and slender, each joint with a few long fine hairs. Joint 3 longest, next comes joint 2, joints 4 and 5 subequal, joints 1 and 6 subequal, joint 8 shortest. Formula, approximately: 3 2 (4 5) 9 (1 6) 7 8. Legs long and stout, quite hairy; trochanter with very long bristle; femur a trifle shorter than tibia; tarsus about one third of tibia. Claw long and slender, with tooth. Digitules fine knobbed hairs. Lobes well developed, with a long seta, and two long fine bristles. Anal ring with six stout hairs. On each segment of the ventral surface, thorax, and on the head, there are numerous very long fine hairs, and there are numerous short fine spines and numerous spinnerets with club-shaped tubes scattered over the body.

Newly hatched larvæ orange colored, elongate oval. Antennæ 6-jointed, quite stout. Formula: 6 3 (1 2) (4 5). Legs short and stout; tarsus as long as tibia. Rostral loop extending beyond last coxæ. Caudal lobes and setæ quite prominent.

On *Stachyos bullata*.

Ceroputo bahiæ Ehrh.

Adult Female.—About 4 mm. long and 3 mm. broad, covered with white cottony secretion, with a distinct ridge of cottony tufts running longitudinally on the meson and two smaller ridges parallel with it. Each ridge has a large tuft at the cephalic end. Margin fringed with short, broad cottony appendages, getting longer toward caudal end. Legs and antennæ dark brown. Color of body is greenish yellow, with a brown patch on the meson. When boiled in KHO turns crimson at first, then derm becomes colorless, except a row of dark brown patches on the body near and running parallel with the margin. These grow larger caudad. Body is densely covered with round glands and stout conical spines. Anal ring large, with six long stout hairs and numerous stout hairs scattered over area surrounding it. Antennæ remain brown. Antennæ 9-jointed, long and stout. Formula: 3 5 9 6 7 4 8 1 2. All joints quite hairy, and joint 9 quite pointed with numerous hairs. Legs long, stout, and thickly covered with very stout hairs; femur and tibia subequal; tarsus about one third of tibia. Claw very stout and curved, with tooth. Digitules very long fine hair.

Immature Male.—Much like female, smaller and lighter color, about 2½ mm. long, 1½ mm. broad, Legs not as stout. Antennæ 7-jointed. Formula: 3 7 2 (1 4 5 6).

Sac of male snow-white, more or less irregular in shape, no distinct carina, about 4 mm. long, 2 mm. broad.

Adult Male.—Measures, without setæ, about 3 mm. long and 1 mm. broad. Head and thorax dark brown, abdomen greenish yellow, slightly covered with white secretion. Antennæ 10-jointed. Formula: (3 4 5) 6 7 8 9 10 1 2. Legs long, stout and very hairy. Wings dusky, pubescent, each about 2½ mm. long by 1 mm. broad. Halteres small, with two stout, well-curved hooks. Style long, stout and conical, forming a blunt hook at caudal end. The last abdominal segment has two groups of round gland openings; on the cephalic margin of each, two very long, stout spines arise, which run parallel caudad. There are also numerous stout hairs surrounding the glands.

On *Bahia* sp.

Pseudococcus aurilanatus Mask.

Adult Female.—Slightly elongated, nearly globulous, of a rich dark purple color, bearing on the dorsum a longitudinal band of bright golden-colored meal, with small patches of similar meal often visible on the edges. In alcohol or potash it produces a rich purple tint, and if crushed in the fingers stains them a dark red. The eggs, which are also purple, are laid in a mass behind the insect in a thin, white cottony web, the mass having thus a general dark gray appearance. Body obscurely segmented, length about $\frac{1}{11}$ inch. Antennæ usually of eight joints, often of seven; in the former case the fourth, in the latter the third, joint is the longest, the rest subequal, except the last, which is fusiform, and nearly equal to the longest; all the joints have a few hairs, the last bearing several.

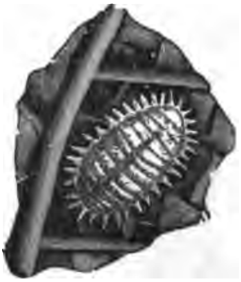


FIG. 7. *Pseudococcus citri.* (Common Mealy-bug.)

On *Araucaria bidwillii.*

This species is commonly known as the "golden mealy-bug," and is quite troublesome in the greenhouses on *Araucaria bidwillii.* I have also found it on the same host plant in the open.

Pseudococcus citri Risso.

(Mealy-bug.)

Adult Female.—Length 3.5 to 4 mm., width 2 to 2.5 mm., white or yellow with brownish tinge, darker than *P. longispinus*, and with less powdery secretions covering body. The seventeen lateral appendages are short and blunt; posterior appendages not much longer than lateral ones. Antennæ 8-jointed, less pubescent than in *P. longispinus.* Formula: 8 3 2 (1 7) (5 6 4). The penultimate segment bears on either side a very long seta and two or three very short ones, and two conical projections; the surface of the segment is dotted with orifices. Six slender setæ, one half the length of the setæ on the penultimate, are borne by the anogenital ring, which is somewhat projected from the penultimate segment. Female oviparous; deposits eggs in cottony sac, which increases in size as the female grows.

On citrus, *Cycas revoluta*, coleus, ferns, and many plants in hothouses.

This is the common mealy-bug and can be found in almost any greenhouse or private conservatory. In a few instances it has been reported as occurring in citrus orchards. In these cases a colony of *Cryptolæmus montrouzieri* (Coccinellid), known as the ladybird enemy of the mealy-bug, soon cleans up the pest. In the greenhouses they do not work so well, as the mature beetle flies against the glass and tries to escape, but in the open they control this pest wherever liberated.

Pseudococcus longispinus Targ.

(Mealy-bug.)

Female.—Length 2.5 to 3 mm., width 1.5 to 2 mm. White or tinged with yellow, with brown band on middle of back; each segment with a white waxy filament, which forms a border of appendages of varying lengths around the body; those near the posterior extremity longer, and four at caudal end very long, the inner the longer, sometimes longer than the body. Entire body appears as if dusted with flour, which is caused by the waxy secretion. Antennæ 8-jointed, each joint bearing seven hairs. Formula: 8 (2 3) (1 5) (4 6) 7. The legs are long, stouter than in *P. citri*, somewhat pubescent; tibia twice as long as tarsus. The penultimate segment presents on either side a rounded group of pores and two short, strong spines, also a seta somewhat longer than the anal setæ, and several shorter setæ. Anal ring large, dotted with six long setæ.

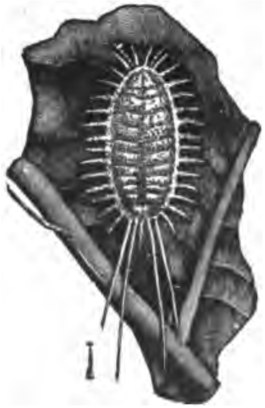


FIG. 8. *Pseudococcus longispinus.* (Mealy-bug.)

Larvæ.—The male and female larvæ are similar to adult female in shape and color, but the male larva has 7-jointed and the female 6-jointed antennæ.

On fern, croton, coleus, citrus, *Cycas revoluta*, and many hothouse plants.

This species differs from *P. citri*, as it has long threads or spines extending from the end of the body. Its habits are the same as *P. citri* and it is usually to be found on the same host plants.

Pseudococcus maritimus Ehrh.

Female.—Elongate oval, about 2 mm. long and 1 mm. broad, flattish, slightly covered with secretion. Color of body, reddish brown. Margin beset with stout, short, white filaments, which grow longer caudad. Caudal setæ about one-half length of body. Legs and antennæ same color as body.

Eggs orange-yellow. Egg sac well developed and has the appearance of *Pulvinaria camelicola*, but smaller—about 5 mm. long and 2 mm. broad.

Young larvæ light orange-yellow.

When boiled in KHO, female turns liquid purple and derm becomes colorless. Body thickly beset with long slender spines and many round glands. Each segment has a group of spinnerets on its margin, in the center of which are two short stout conical spines. Antennæ 8-jointed, quite hairy. Joint 8 always longest, and joint 4 generally shortest, although joint 6 sometimes is shorter than 4; again, joints 4 and 6 are sometimes equal. The following formulæ will assist in determining the species: 8 2 (1 3) (5 7) 6 4. 8 2 (1 3) 5 (4 7) 6. 8 3 2 1 (5 7) 6 4. 8 1 (2 3) 5 7 (4 6).

Legs quite hairy, well developed, long and slender. Trochanter with long stout spine (128μ). Femur about as long as tibia. Tarsus about a third as long as tibia. Claw short and stout. Digitules fine knobbed hairs. Caudal lobes prominent, with moderately long setæ and two very stout conical spines. Anal ring large, with six very long stout hairs.

On *Eriogonum latifolium.*

Pseudococcus quercus Ehrh.

Female.—Slightly covered with white secretion, about 2½ mm. long and 1½ mm. broad, tapering at both ends. Color of body greenish brown, concealed more or less by secretion. Segmentation very distinct. Each segment bears a white filament on the margin. Caudal setæ about one third as long as body, white and very stout. Antennæ and legs dark brown. When placed in boiling KHO, body turns crimson; derm becomes colorless after boiling. Antennæ 8-jointed; joint 8 longest, joint 7 generally shortest. Formula, approximately: 8 3 2 (1 5) 6 4 7. Each joint has a ring of stout hairs. Joint 8 has numerous very long hairs. Legs long and stout, with numerous long fine hairs; femur about as long as tibia; tarsus about a third as long as tibia; claw slender and well curved. Digitules long fine knobbed hairs. Anal ring small, with six fine hairs. Caudal lobes well developed, with very long setæ (280 μ). Groups of spinnerets, conical spines, and long slender hairs scattered over the dorsum.

On *Quercus chrysolepis.*

Pseudococcus ryani Coq.

This species is known as the cypress mealy-bug and is held in almost complete subjection by the Coccinellids (ladybirds), *Rhizobius ventralis* and *Exochomus marginipennis.* Of the sixteen species of *Pseudococcus* found in California, *P. citri*, *P. longispinus*, and *P. aurilanatus* are the most troublesome, although where New Zealand flax is grown *P. calceolariæ* is very abundant.

Erium eriogoni Ehrh.

Female.—Inclosed in a densely woven white felt sac about 2½ mm. long and 1 mm. broad; also secreting considerable loose cottony matter. Color light yellow, slightly covered with white powder, about 2 mm. long and 1 mm. broad. Last segment of body with two short white filaments. Legs and antennæ light brown. Young larvæ and eggs light yellow. When boiled in KHO, turns brown. Numerous very fine slender spines on dorsum. Antennæ 7-jointed, quite bristly. Sequence of the joints of the antennæ is quite variable. Joint 7 longest, then comes 3, then 1 and 2, but these are sometimes longer than 3. Joint 4 is next, but sometimes joint 6 is longer. Joint 5 is generally shortest. Formula, approximately: 7 3 1 2 4 6 5. Legs small and rather slender; femur, tibia, and tarsus all bearing rather large stout bristles; femur twice as long as tarsus; claw slender. Tarsal digitules long, slender, slightly knobbed. Digitules of claw slightly longer than claw, slender, knobbed. Anal lobes not conspicuous, bearing a long, rather stout seta, several stout conical spines, hairs and spinnerets. Anal ring median, with the usual six hairs.

On roots of *Eriogonum* sp.

Ripersia villosa Ehrh.

Female.—In clusters and single in the crotches of twigs of oak. Sac loosely woven of long white wool, oval, about 2 mm. long and 1 mm. broad.

When removed from sac bright crimson, slightly covered with white powder, skin shiny; about 1.5 mm. long, 1 mm. broad, tapering anteriorly and quite convex dorsally. When boiled in KHO, derm colorless, densely covered with slender hairs. Antennæ light brown;

7-jointed, joint 7 longest; sometimes joint 1 is next longest, but joint 2 is often longer than joint 1, and in many cases they are subequal; joint 6 usually next, although joint 3 may be longer than 6; joint 4 next, often subequal with 5; sometimes 3 shortest, sometimes 5; 3 and 5 often subequal. In fact, the sequence of the joints is quite variable, as is shown in the following antennal formulæ: 7 2 1 (3 6) (4 5). 7 (1 2) 6 (4 5) 3. 7 1 2 6 4 (5 3). 7 (1 2) 6 4 (5 3). Joint 1 is stouter than any of the others. Each joint with hairs, joint 7 with several stout hairs. Legs light brown, large and stout; each joint furnished with one or more rather long bristles. Femur, 80 × 50 μ; tibia, 70 μ; tarsus, 50 μ; claw, 20 μ. Digitules of claw knobbed, moderately short and stout. Tarsal digitules long, fine, slightly knobbed hairs. Tubercles small and rounded, with long stout bristle. Anal ring with six stout hairs.

Larva, when newly hatched, color light red, rostral loop extending beyond body.

On *Quercus agrifolia*.

Subfamily **COCCINÆ.**

Pulvinaria innumerabilis Rathv.

This scale insect somewhat resembles the cottony-cushion scale (*Icerya purchasi*) and is often mistaken for it. It can be easily distinguished, however, being much smaller and the general appearance differing materially.

Female.—Oval in form; color dark brown. Near the posterior end are ridges, and the lines that separate them are darker than the other parts. The eggs are laid in the cottony sac; they are white when first laid, but change to a yellowish tinge before hatching. They are oval in form. The larva is yellowish white.

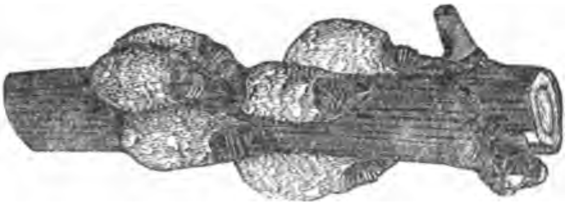


FIG. 9. *Pulvinaria innumerabilis* (Cottony Maple Scale). On Grape.

At one time this species was very troublesome, but the internal parasites *Coccophagus lecani* and *Encyrtus flavus* work on this pest most effectively in the larval form, and the *Rhizobius ventralis* clean up the egg sacs of those that escape the attack of the parasites in the larval form and mature.

The other species of *Pulvinaria* found in California are of no economic importance.

Pulvinaria camelicola Sign.

The female of this species is not unlike *Coccus hesperidum*, but the formation of the white ovisac is a clearly distinguishing character. In late summer the female often drops off to the ground, leaving only the ovisac observable on the leaf. According to Maskell, the adult female is yellowish or reddish brown, naked, slightly convex, elongated; skin smooth, with puncta; length variable, from about $\frac{1}{7}$ of an inch to $\frac{1}{6}$ of an inch. Antennæ, according to Signoret, with sometimes 6, sometimes 7, joints. Abdominal clefts and lobes normal. The insect excretes a narrow, white, cylindrical, cottony ovisac, which is conspicuous on the leaf of the plant, and the brown body of the female can be seen at one end of it. The eggs in the ovisac are numerous, perhaps some hundreds.

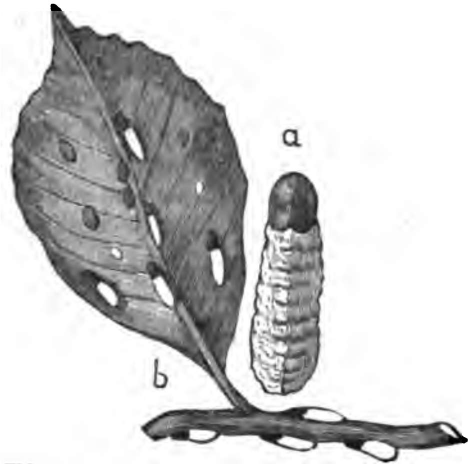


FIG. 10. *Pulvinaria camelicola.* *a*, female, greatly enlarged; *b*, natural size, showing position of scales on limb and leaf.

Larva in second stage of female flat, oval, yellowish brown.

On *Camellia japonica* in greenhouses.

Pulvinaria psidii Mask.

Adult Female.—Yellow or yellowish brown, sometimes with a greenish tinge; size variable, reaching $\frac{1}{12}$ of an inch before the ovisac is formed, but shriveling at gestation. The ovisacs cover the twig or leaf with masses of dirty-white cotton, usually accompanied by black fungus. Antennæ rather long and slender, of 8 joints, of which joint 3 is longest, joint 8 next, and the rest shorter and subequal. Feet also rather long; the trochanter is large, and bears a very long hair; tarsus curved, and about half as long as the tibia; upper digitules fine hairs, lower pair long and dilated at the end. Abdominal cleft moderate; anogenital ring with several hairs. The margin of the body bears a row of spiny hairs.

Female of the second stage yellow, flattish, elliptical; length about $\frac{1}{20}$ of an inch. Antennæ 6-jointed.

Larva yellow, flat, elliptical. Antennæ 6-jointed.

Male unknown.

On ferns, orange, coffee, pomegranates, and alligator pears at quarantine.

This species was very destructive to the coffee plantations of the Sandwich Islands, but since the introduction of the ladybird *Cryptolæmus montrouzieri* from California it has been cleaned out.

Pulvinaria rhois Ehrh.

Female.—Found on limbs and under side of leaves, single and in clusters. Length of female with ovisac, about 9 mm., width about 3.5 mm.; scale brown, largely covered with white secretion, ovisac snow-white, distinctly grooved longitudinally, sometimes curved, sometimes lifting scale off limb; scale shrunken, broadly oval, clay color. Female before forming ovisac something like *Coccus hesperidum*, but more convex, reddish brown; anal plates distinct; dorsum covered with white, waxy secretion in rows, the mesal row has the largest secretions, and they diminish in size as they approach the margin; edge of scale has short, simple hairs; in each anterior incision is a large spine, with a short one on each side. Anal plates yellowish brown, longer than broad, forming a diamond when closed; two very small spines at tip; anogenital ring with six long hairs; rostral loop reaching to middle pair of legs. Antennæ 8-jointed; formula: 3 (1 2 4) 5 8 6 7. Joint 3 much the longest, joints 2, 4, 5, and 6 each with long hair, joint 8 with several hairs. Legs ordinary, coxa and trochanter very stout, tarsus half as long as femur; tarsal digitules long fine hairs with knobs.

Larva.—Light yellow, flattish, elliptical, about 0.5 mm. long.

Male.—Small, oval, black, with numerous pale, wart-like prominences.

On *Rhus diversiloba.*

Ceroplastes cirripediformis Comst.

(Barnacle Scale.)

Adult Female.—Average length 5 mm., width 4 mm., height 4 mm. When naked the color is dark reddish brown; the shape sub-globular; with a strong spine-like projection at the anal end of the body. The waxy covering is dirty white, mottled with several shades of grayish or light brown, and even in the oldest specimens retains the division into plates, although the form is more rounded and the dividing line by no means as distinct as at an earlier age. There are visible a large convex dorsal plate, and apparently six lateral, each with a central nucleus; the anal plate, however, is larger, and shows two nuclei, and is evidently two plates joined together. Antennæ 6-jointed. Legs long; tibiæ nearly twice as long as tarsi; digitules of the claw very large. The other tarsal pair very long and slender, but with a very large button. The skin is seen in places to be furnished with many minute, round, transparent cellules, probably spinnerets, and along the border are small groups of constricted arrow-shaped tubercles, but there are no bristle-shaped spinnerets.

On pepper-tree.

Ceroplastes floridensis Comst.

(Florida Wax Scale.)

Adult Female.—Sub-globular in form, the point of attachment to the twig or leaf being concave. Length, from 2.5 mm. to 3 mm. Color, when naked, reddish brown; covered with an apparently homogeneous layer of waxy excretion, which is usually brownish on the dorsum and dirty white toward the edges; some specimens are irregularly mottled brownish and yellow-white. Antennæ 6-jointed, joint 3 nearly as long as all the others together. Legs normal in all respects. The margin of the body in the region of the stigmata is furnished with groups of minute arrow-shaped tubercles, constricted at the base, and between these groups are bristle-shaped spinnerets.

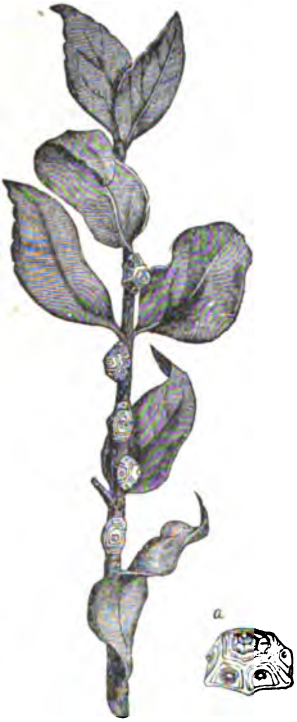


FIG. 11. *Ceroplastes cirripediformis* (Barnacle Scale). Branch infested with scale. *a*, female, much enlarged.

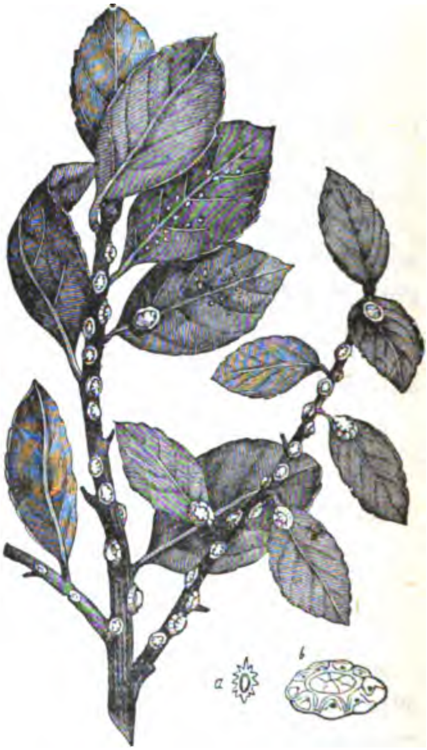


FIG. 12. *Ceroplastes floridensis* (Florida Wax Scale). *a*, young female; *b*, adult female, much enlarged.

On citrus, mango. (At quarantine.)

Ceroplastes irregularis Ckll.

In certain sections this *Ceroplastes* can be found very abundant on sagebrush in the foothills, but has not attacked any other host plant as yet, and has been known in California for a great many years. One other species has attacked a pepper-tree in this State, but the tree was cut down and burned and its presence has not again been noticed. Owing to the fact that it was discovered in a section where the strictest inspection is maintained, it is safe to say that it will not gain a foothold.

Ceroplastes ceriferus Anderson.

(White Wax Scale.)

Female.—Test of adult female white or yellowish white, waxy, convex, thick; frequently agglomerated in large masses covering the twigs of the food-plant (as shown in Fig. 13). Separate individuals may range in size from ⅕ to ½ of an inch. Marginal tuberosities not distinguishable, though the margin is sometimes slightly flattened and irregular. The apex of the test is sometimes produced in a short pointed horn, not erect but bent over the test. The wax is rather soft and greasy. Test of the second stage slightly convex, elliptical; color grayish white. Median dorsal region usually smooth, separated by a narrow depression from the marginal region, which exhibits eight tuberosities, three on each side and two terminal. Average length of test about ⅐ of an inch.

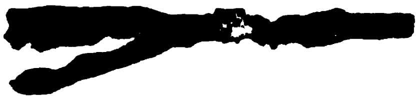


FIG. 13. *Ceroplastes ceriferus* (White Wax Scale). Infesting camellia.

Adult female brown, very convex, elliptical, hollow beneath. Form lecanid, but the anal cleft and lobes are not easily made out, being contained in a conspicuous cylindrical "tail" or prolongation of the abdomen. Antennæ 6-jointed, joint 3 being much the longest. Feet rather thick, but not at all atrophied; tibia scarcely longer than the tarsus; upper or tarsal digitules slender knobbed hairs, lower pair on the claw rather long, thick, and expanded at the end. Rostrum rather large; mentum doubtfully dimerous. Near the spiracles, on each margin, is a group containing eight large conical spines and about twenty-four smaller ones. Epidermis bearing many circular spinneret orifices. When the "tail" is subjected to the action of potash and subsequent pressure it is seen to contain at its extremity the abdominal lobes and the anogenital ring, which has six rather strong hairs.

Female of the second stage brown, elliptical, slightly convex. Form lecanid, exhibiting the normal cleft and lobes; there is no "tail," but the region surrounding the lobes is thickened. Antennæ and feet as in the adult, but the feet are more slender. The margin bears a row of very fine spiny hairs, and four spiracular groups of large conical spines. There are many small circular spinnerets on the epidermis.

Larva yellow, elliptical, flattish; length about $\frac{1}{70}$ of an inch. Form normally lecanid, the anal lobes bearing long setæ. Antennæ thick, with six rather confused joints.

Male unknown.

On camellia. (In greenhouse.)

I have often met with this scale on many plants from Japan at the quarantine station in San Francisco. Judging from the number found infested it must be plentiful in that country. The camellia on which I found it in California was in a Japanese nursery, and was promptly destroyed.

Eucalymanatus perforatus News.

Adult Female.—Irregularly oval, bluntly acuminate in front, broadly rounded behind; sometimes almost dull colored; usually asymmetrical; flattish; median area very slightly convex, margins very thin. Under surface flat; a small hollow on each side of abdomen. Color dark castaneous, paling to fulvous or greenish yellow at margin. Dorsal area divided into numerous irregular plates, forming an intricate marqueterie pattern, more conspicuous after treatment to potash. The pattern is roughly but not absolutely symmetrical on the two sides of a median line. The number of separate tesseræ vary slightly in different individuals by the confluence of adjoining plate, but the main plan is constant, viz., four series on each side of the median line, indicated on the surface by a series of depressed, irregularly polygonal spaces, divided by slight carinæ. Dermal cells numerous but ill-defined, irregularly oval, groups of them often forming irregular rosettes; but there is also near the margin of each plate, more particularly on those of the median series, a series of minute translucent pores, bearing a fanciful resemblance to rivet holes for the attachment of armor plates. Eyes minute, black, marginal. Marginal hairs small, simple. Submarginal tubercles five to seven on each side. Stigmatic clefts with three (rarely four) stout spines, the median one longest and projecting beyond the margin Anal cleft rather more than one quarter the total length of the insect Scales of anal operculum together forming a square, their extremities rather acutely pointed. Anal ring with six hairs; two or three stout

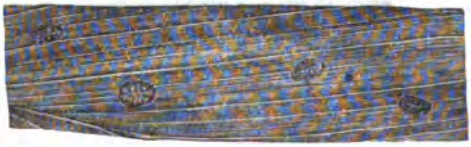


FIG. 14. *Eucalymanatus perforatus.* Section of palm leaf infested with scale.

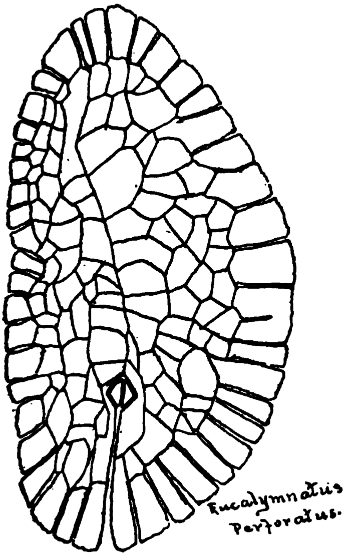


FIG. 1. *Eucalymnatus perforatus*, dorsal aspect.

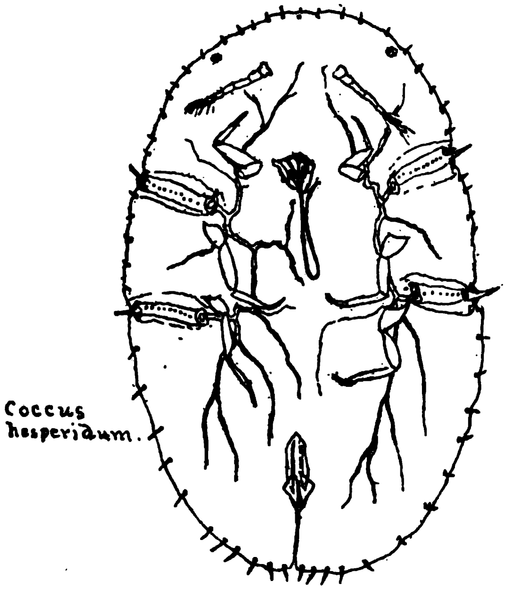


FIG. 2. *Coccus hesperidum*, ventral aspect.

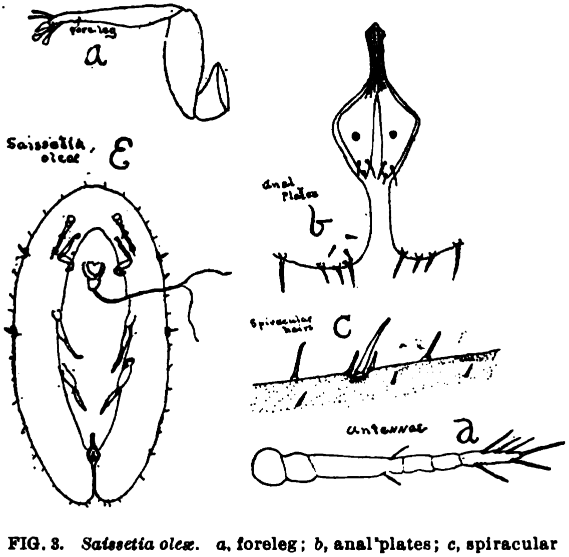


FIG. 3. *Saissetia oleæ*. *a*, foreleg; *b*, anal plates; *c*, spiracular hairs; *d*, antennæ; *e*, *Saissetia oleæ*, ventral aspect.

C. T. P., del.

DETAILS OF CALIFORNIA COCCIDÆ.

hairs, each surmounting a small conical tubercle, on each side of ventral aperture. Antennæ with eight joints, the divisions between third and fourth often very indistinct, division between seventh and eighth diagonal; formula variable, joint 8 always considerably the longest, joints 6 and 7 shortest, joints 2 to 5 subequal. Legs rather small but well developed; tarsus shorter than tibia; digitules normal. Length, 3 to 4.75 mm.; breadth, 2 to 3 mm.

Young larvæ crowded beneath the body of the parent, which is apparently ovoviviparous.

Male unknown.

On palms. (In hothouses.)

Coccus hesperidum Linn.

Adult Female.—Bright yellow or greenish yellow, minutely specked by red-brown, with specks sometimes agglomerated into transverse bars, especially on the median abdominal regions; in other parts tending to form dotted lines radiating from center to margin. Dried specimens straw colored and much wrinkled. Form oblong-oval, often very irregular in outline; narrowest in front; more or less convex above, according to age. Eyes minute, black, marginal. Stigmatic clefts with three spines; the median one very long and pointed, projecting well beyond margin. Marginal hairs simple, pointed; rarely a few, more particularly at posterior extremity, divided or frayed at tip. Submarginal tubercles, four to five on each side. Scales of anal operculum with outer edge slightly longer than base; the latter slightly concave in outline. Derm cells scattered, small, circular, inconspicuous. Antennæ 7-jointed; formula: (3 7) 4 2 1 6 5. Legs normal. Anal ring with eight stout hairs. Length, 2.25 to 3.50 mm.; breadth, 1.25 to 2.50 mm.

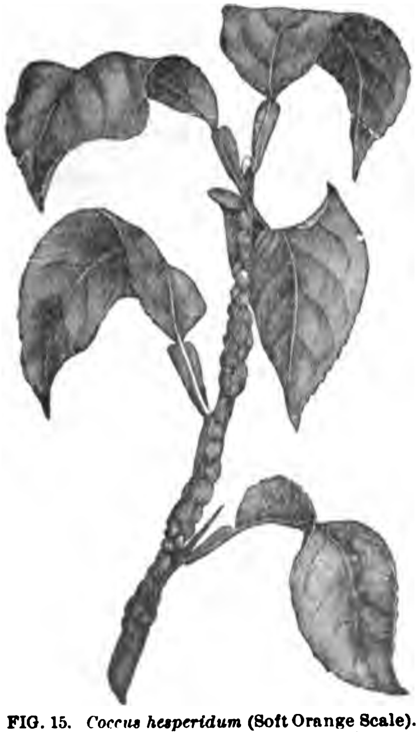


FIG. 15. *Coccus hesperidum* (Soft Orange Scale). An orange branch thickly infested.

The insect is ovoviviparous; living larvæ are usually found beneath the body of the parent.

On orange, lemon, grape-fruit, oleander, ivy, myrtle, and various other plants.

This scale at one time was considered quite a pest by the citrus-growers of this State, and is commonly known as the soft orange scale. It is completely held in check by internal parasites and is not considered a pest now.

Coccus ventralis Ehrh.

Scale of Female.—About 4½ mm. long, 3 mm. broad, 1 mm. high. Oval when seen from above. Soft texture, very much like *C. hesperidum;* light brown, not very convex, and a dark brown border near margin. Dorsum pitted and margin moderately wrinkled, an indistinct mesial ridge.

Female.—Color greenish yellow, with a brown longitudinal line on the dorsum, also two brown lines forming a double cross with the dorsal line, more or less wrinkled and pitted. Ventral view shows the abdomen a dark purple brown with very distinct segmentations. Viviparous.

After boiling in soda, derm colorless. Margin with small curved spines. Lateral incisions with long, stout, curved spine and two shorter ones. Anal plates large, with blunt tips, bearing several hairs and notched on outer margin, together forming a square. Each plate has a distinct brown projection into the body. Anogenital ring with six hairs, which are very long, extending two thirds over the plates. Legs stout, coxa and femur each with a stout hair; femur one third longer than tibia. Tarsal digitules long, knobbed hairs, digitules of claw broad and thick. Claw stout and curved. Antennæ 7-jointed; formula: 3 4 7 2 1 (5 6). Joints 1 and 2 with two hairs each, 4, 5, 6, and 7 with several hairs; joint 3 very little longer than 4; 5 and 6 subequal.

Larva lemon-yellow, very flat, shiny, oval, about twice as long as broad.

On tuberous plants (in Japanese garden).

Parasites: *Encyrtus flavus* and *Coccophagus lecanii* were reared from this species.

Eulecanium armeniacum Craw.

(Apricot and Prune Scale.)

Adult Female.—Color light brown. In shape resembles *Coccus hesperidum,* but is much larger and more convex. In the center of the dorsum is a prominent shining circular protuberance, from which radiate a number of small ridges; these are more noticeable upon the posterior half of the scale. From the convex center to the anus is a low carina, also noticeable in front. Length, from .20 to .27 of an inch; width from .12 to .15 of an inch; height, from .05 to .10 of an inch. Antennæ tapering to the point, 7-jointed; joints 1 and 3 subequal; joint 2 nearly three times as long as joint 1; joint 4 slightly longer than joints 5 and 6; joint 7 is nearly same as joint 3, and tapers to a point; a few bristles at the tip and upon each joint.

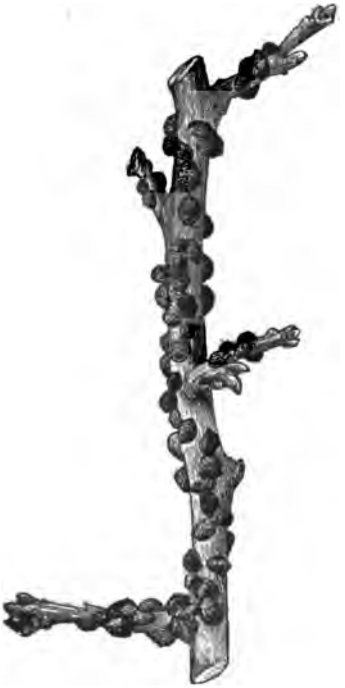


FIG. 16. *Eulecanium armeniacum* (Brown Apricot Scale). Showing scales on prune branch; about natural size.

Eggs.—These are smaller and lighter colored than *Saissetia oleæ.*

Larvæ.—Are long, oval, light yellow, darker down the center, and can be distinguished from the larvæ of *oleæ* in not having the four reddish-brown marks upon the dorsum.

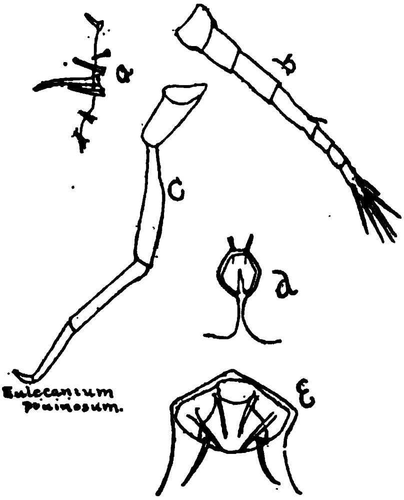
Like other species of *Eulecanium* that produce but one generation a year, their development is slow. They generally hatch in June and locate upon the leaves, where they go through their molt, and then move to the young wood. In the spring they grow rapidly and throw off great quantities of excrement, into which the spores of the black smut (*Fumago salicina*) adhere and grow, injuring the health of the tree and the market value of the fruit.

On apricot, prune, plum, cherry, peach, pear.

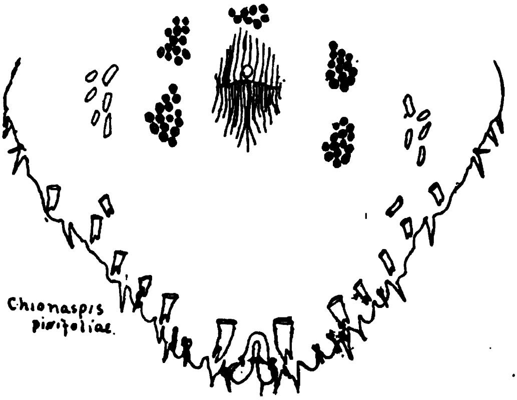
This species is commonly known in this State as the brown apricot scale and is usually associated with *E. pruinosum.* The parasite *Comys fusca* has held this scale in subjection for many years, usually accomplishing the work the second year after a colony has been liberated.

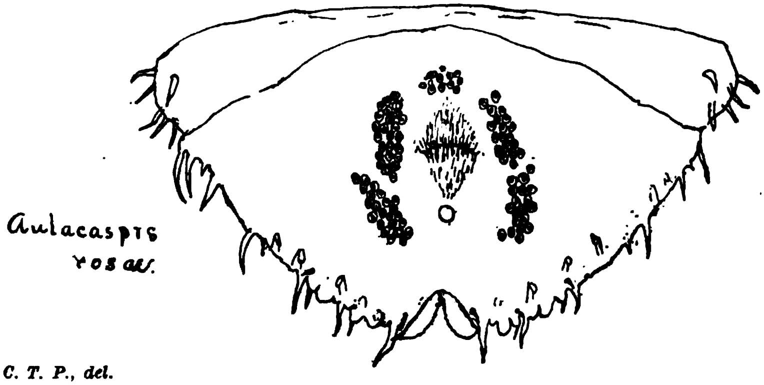
Eulecanium cerasorum Ckll.

This pest was first noticed in this State in 1904, a party having brought in a branch of English walnut which was quite thickly infested with the scale. Since then it has been found on pear trees. Dr. Howard kindly verified my identification of the specimen sent at that time as *Eulecanium cerasorum.* In tracing back the introduction of this pest I find it came from Japan on an ornamental plant, which was planted under the walnut tree above mentioned.



a, spiracular hairs; *b*, antennæ; *c*, hind leg; *d*, anal plate; *e*, anus.





C. T. P., del.

DETAILS OF CALIFORNIA COCCIDÆ.

Eulecanium crawii Ehrh.

Female.—Scales not crowding each other; hemispherical, about 3 mm. long, 2 mm. broad, and 1½ mm. high; oval, shiny, brown, getting darker with age. Margin generally lighter than dorsum.

Before gestation light brown, shiny. Derm, by transmitted light, brown, with numerous oval gland-orifices. Marginal hairs very short and slender. Lateral incisions each with three stout but not long spines. Antennæ 7-jointed; joint 3 longest, twice as long as 4; joints 5 and 6 very short, joints 1 and 2 about equal. Formula: 3 4 7 (1 2) 5 6. Anal plates broad, but not very large. Anogenital ring with six moderately slender hairs. Legs quite stout; coxa and femur with stout hair; femur very little longer than tibia; tibia and tarsus about equally long. Claw stout and curved. Tarsal digitules moderately stout, knobbed hairs. Digitules of claw not stout, a little longer than claw, more or less club-shaped.

Larva light yellow, with distinct ridge on dorsum, dividing scale lengthwise. Oval, about twice as long as broad. Rostral loop extending to third pair of legs.

On *Acer macrophyllum.*

Parasite: *Comys fusca* was reared from this species.

Eulecanium pruinosum Coq.

(Frosted Scale.)

Adult Female.—Pale brownish, thinly covered with a whitish powder, which does not conceal the ground color. Body oblong in outline, very convex above, not distinctly carinate, the surface very uneven. Margins nearly perpendicular; dimensions as follows: Largest specimens, length, .28 of an inch; width, a trifle over .20 of an inch; height, .12 of an inch. Smallest full-grown specimen, length, .16 of an inch; width, .12 of an inch; height, .08 of an inch. Antennæ much thickest at the base, 7-jointed; joint 6 the shortest, then 5, then 1 and 2, which are subequal in length; joints 3, 4, and 7 are also subequal in length, each nearly twice as long as 6; joint 7 tapers to the tip, and is furnished with a style, being about three fourths as long as this joint; anal cleft

FIG. 17. *Eulecanium pruinosum* (Frosted Scale). On prune; about natural size.

and lobes normal. The eggs are of the usual ovoid form of the *Eulecaniums*, and of a yellowish-white color, and are laid in May, June, and July.

Larvæ.—A few weeks after the eggs are deposited, the larvæ hatch out from under the old scale; they are of a pale color, having a distinct dorsal ridge extending the entire length of the body, and with many smaller ones (about twenty-four on each side) extending from it to the margin, some of them being divided into two branches.

The larvæ as soon as hatched locate upon the leaves; their development is slow until they take up their position upon the under side of the young shoots, where they remain throughout the winter, and, in fact, the balance of their lives. Upon the ascent of the sap in the spring they grow rapidly, and in April they assume the characteristic powdery or frosted appearance peculiar to this species.

On apricot, peach, prune, plum, pear, apple, rose, grapevine, hawthorn, and occasionally on orange.

This scale was first observed in California in 1887 on apricot. Several species of *Coccinellidæ* attack the young of this scale, also other predaceous insects, and have succeeded in keeping this species from becoming troublesome.

Eulecanium pubescens Ehrh.

Female.—Scale about 4 mm. long, 2½ mm. broad, and 2 mm. high, moderately soft, before gestation covered with very soft hair. Color blackish brown, more on the black, with a yellow longitudinal band on the dorsum. Dorsum pitted and margin slightly wrinkled. Some specimens show a lighter color. When removed from twig the insect leaves a small amount of white powder. Derm, by transmitted light, colorless, except margin, which is light brown, with numerous small round gland-pores. Margin with a double row of minute simple spines, lateral incisions with one moderately stout spine and two short ones. Anal plates large, outer corner forming a right angle, with several hairs at tip, and a long, stout hair on each plate. Anogenital ring with six long, stout hairs. Legs slender; tibia and tarsus about equal; femur a little longer than tibia; coxa, trochanter, and femur each with a hair. Claw curved, with slender knobbed digitules. Tarsal digitules with very fine, long, knobbed hairs. Antennæ 7-jointed; formula: 4 3 (1 2) 7 (5 6). Joint 4 very little longer than 3; joints 1, 2, 4, 6 each with a hair; joint 7 with several hairs.

Male.—Scale glassy white with median ridge, about 1½ mm. long. Body dark red-brown; legs and antennæ light brown. Wings extend one third beyond body; color iridescent. Thorax with two elevated ridges much darker than body. Antennæ very hairy.

On *Quercus* sp.

Eulecanium tulipiferæ Cook.

This species is known as the "soft tulip scale," and is quite a serious pest in the East. It was first noticed in California in 1905, but had evidently been here for some time, as I found quite an extensive area infested. The species seems to confine its attack to cherry trees, usually on the under side of the larger lowest limbs.

This is a very large *Eulecanium* (?), dark brown in color, about ¼ of an inch high and of about the same width. The scale has a rather frosted appearance, in this respect somewhat resembling *E. pruinosum*, only much larger. There are two distinct irregular, black longitudinal lines on the dorsal surface of the scale. Steps were immediately taken to control its further spread and to eradicate the present infestation.

Saissetia hemisphærica Targ.

(Hemispherical Scale.)

Adult Female.—Shape approaching hemispherical, with the edges flattened. Average length, 3.5 mm.; width, 3 mm.; height, 2 mm. The shape and proportion vary somewhat, according as the scale is formed upon a leaf or twig. Upon the rounded twig it loses something of its hemispherical form, becomes more elongate, and its flattened edges are bent downward, clasping the twig. The color varies from a very light brown when young to a dark brown, occasionally slightly tinged with reddish, when old. The oval cells of the skin vary in length from .01 mm. to .04 mm.; and each cell contains a large granular nucleus. The antennæ are 8-jointed, with joints 1 and 2 short and thick; joint 3 is the longest, and the succeeding joints decrease gradually in length to joint 8, which is longer than the preceding. The legs are long and rather slender. The bristle on the trochanter is long. The articulation of the tarsi is very well marked. The tarsal digitules are, as usual, two long and two short; those of the claws spreading widely at summit and very stout at the base. The anogenital ring is furnished with eight long hairs. The anal plates are triangular, with rounded

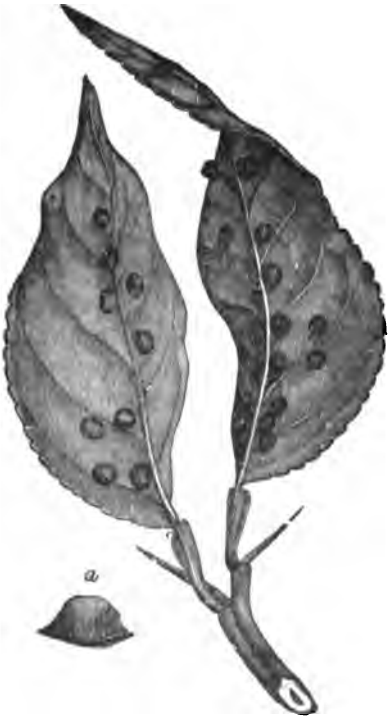


FIG. 18. *Saissetia hemisphærica* (Hemispherical Scale). On orange. *a*, female, greatly enlarged.

corners, and are furnished with two long hairs upon the disk and three much shorter ones at the tip.

On orange, lemon, grape-fruit, oleander, pepper, ferns, sago palms, etc.

The parasite *Scutellista cyanea* also attacks this species, and where it is found in the open holds it in subjection.

Saissetia oleæ Bern.

(Black Scale.)

Adult Female.—Densely chitinous; dark brown, almost black in color, surface roughened and minutely specked with small grayish waxy granules. Form highly convex; length, 4 to 5 mm.; height, 3 mm. Dorsum with a median longitudinal carina, and two transverse carinæ, the latter dividing the body into three subequal portions; frequently the longitudinal ridge is more prominent between the transverse ridges than elsewhere, thus forming with them a raised surface of the form of a capital H. Eyes inconspicuous. Scales of anal operculum pointed at extremities; outer edge rounded; base straight or slightly concaved; outer edge twice length of base. Marginal hairs rather long; extremity dilated and often deeply divided. Submarginal tubercles six on each side. No stigmatic cleft. Stigmatic spines three, prominent and sharply pointed, the median spine nearly four times the length of the others. Antennæ with eight joints, of which the third is always the longest. Legs rather slender; tarsus about three fourths length of tibia; digitules of claw rather long. Dermal cells large, irregular polygonal, with rounded angles; the margin of each cell distinctly

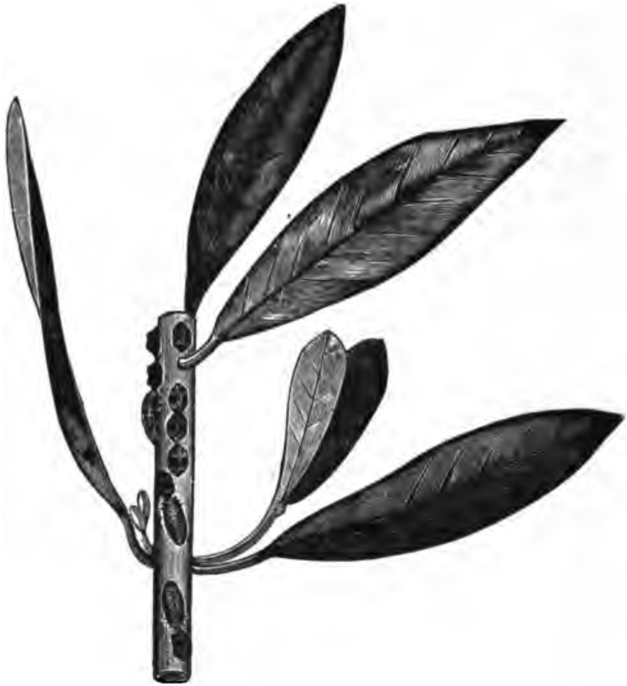


FIG. 19. *Saissetia oleæ* (Black Scale). On olive branch, showing the larvæ of the ladybird *Rhizobius ventralis* at work destroying the scales.

marked on the surface. On the denser marginal area the cavities of the cells are filled with a dark brown deposit, and (in very old scales) all the cells may be similarly darkened.

Early adult female and female of second stage dull pale brownish yellow.

Male Puparium (observed in California).—Grayish color, but almost colorless; length, 1 to 1.5 mm.; width, from .5 to .8 mm.; very glassy; oval. Dorsum with distinct longitudinal carina and two delicate transverse carinæ.

Winged Male.—Orange color, with lighter-colored wings; length of body, exclusive of style, 1.2 mm.; style, .4 mm.; anal plates, .5 mm. Antennæ 10-jointed; the first three joints are short, the second is swollen and pyriform, the fourth is longest and equal to the first three in length; balance of joints gradually diminish in size. Entire length of antennæ, .55 mm.; wings, 1.1 mm. Legs slender and about .8 mm. in length. Eyes six in number—two anterior compound, two ocelli at sides of head, and two compound eyes at posterior part of head. (B. W. Griffith.)

On orange, lemon, grape-fruit, olive, peach, prune, plum, apricot, apple, pear, pomegranate, oleander, rose, and many other plants.

In California the males begin to issue from the pupæ the latter part of November. I have male pupæ before me now that were collected the first of November last year.

This is the "black scale" of the olive and orange, although it has a great range of food plants and is one of the most widely distributed scales of California, being found practically in almost every section. An internal parasite, *Scutellista cyanea*, introduced a few years ago from South Africa, has in many cases completely controlled this pest and is swiftly robbing it of its terror. The ladybird enemy, *Rhizobius ventralis*, has for many years done excellent work against this pest and in certain favorable localities has held it in subjection.

Aclerda californica Ehrh.

Female.—Covered with wax resting on a thin white secretion. Color orange-ferruginous, shiny, varying greatly in size and shape. The average specimens are about 3 mm. long, 1½ mm. wide, and 1 mm. high; generally pyriform, but it is difficult to give any special form, as the insect adapts itself to the position on the plant. After boiling in KHO derm is colorless, mouth parts, glands, and caudal portion remaining brown. There are indications of antennæ, which are very small and very bristly, segmentation not visible. There are four large disk-like spiracles on the ventral surface; each disk contains numerous glands. There is a row of thick, blunt spines on each margin, and one on the dorsum. These marginal spines are shaped like a spearhead set in a socket. With these there are several rows of round spinnerets. Rostrum attached to a prominence, which, however, varies with the position the insect adopts. End of abdomen strongly chitinized, with the margin strongly crenate and plicate, and deeply cleft in the middle as in *Eulecanium*. Numerous round glands scattered near its margin, and several strong spines on margin at intervals. Anal ring with numerous (eight?) stout hairs. On the ventral surface opposite the anal ring there is a round projection with four stout spines. This is inserted in the cleft of the anal lobes.

On roots of bunch-grass.

Physokermes insignicola Craw.

This is a large, almost spherical dark brownish-black scale which infests the Monterey pines (*Pinus insignis*). When a tree becomes infested it presents a sickly, stunted appearance, with scant foliage, and is covered with honey-dew and black fungus. The scales cluster very thickly around the small shoots and usually at the tip of the branches. They are oviparous, with but one generation a year. The young are elongated, dark brown in color, with a short fringe along the edges and a deep abdominal cleft. As soon as they hatch they attack the tender pine shoots, afterwards removing to the harder wood, where they locate permanently.

FIG. 20. *Physokermes insignicola*, a large, almost black, spherical scale, infesting the Monterey pines.

The *Rhizobius ventralis* (Coccinellid) and an internal parasite do good work toward controlling the ravages of this pest. In isolated cases, however, where the insect enemies of this scale have not made their appearance, I have found many trees that have been killed by the scale.

Subfamily **DIASPINÆ.**

Chionaspis ortholobis Comst.

(Willow Scale.)

Scale of Female.—Moderately elongated, broadest near the middle of the scale; dirty white. Exuviæ .8 mm. long, brown.

Female.—Median lobes straight and parallel, having the appearance of being set closely together; rounded on their extremities, sometimes obscurely serrate on the sides. Second and third pairs, with the inner lobule larger than the outer, a little oblique; entire or obscurely serrate.

The gland-spines are arranged as follows: 1, 1–2, 1–2, 2, 4–5. The first one is small and blunt. Second row of dorsal gland-orifices represented by the anterior group consisting of 4–7 orifices. Third row with 7–9 orifices in anterior and 5–8 in the posterior group. Fourth row with 10–11 orifices in the anterior and 5–9 in the posterior group. Median group of circumgenital gland-orifices, 10–25; anterior laterals, 18–35; posterior laterals, 16–24.

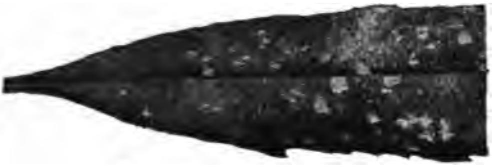


FIG. 21. *Chionaspis ortholobis.* On section of willow leaf.

Scale of Male.—Length, .6 to .8 mm. Oval, without carinæ; exuviæ pale brown or almost colorless.

Eggs.—Dark purple in color.

On willow.

Chionaspis pinifoliæ Fitch.

(The Pine-leaf Scale.)

Scale of Female.—Snow-white; with bright orange or brown exuviæ, shape depending upon width of leaf or host, but usually broadened posteriorly and very convex. Length, 3 to 4 mm.; length of exuvia about 1 mm.

Scale of Male.—Length, 1 to 1.5 mm. The pale yellow exuvia occupies about one third the length of the tricarinate, posteriorly broadened scale.

Female.—Three pairs of well-developed, thin, striate lobes; the median almost circular in outline, entire, separated by about one third their width, slightly diverging at the apex and joined anteriorly by an arched chitinous process. Inner lobule of second and third lobes the larger and subtruncate. The gland-spines are arranged as follows: 1, 1, 1, 1, 1–3, becoming shorter toward median lobes. The spines on the ventral surface are short and inconspicuous, situated over mesad of the base of the first, second, third, and fourth gland-spines respectively. Those on the dorsal surface are longer and situated mesad of the corresponding ventral spine. Second row of dorsal pores represented by anterior group of 2–4; third row by 3–5 in anterior and 4–6 in posterior group. Median lobes of circumgenital gland-orifices, 7–13; anterior laterals, 12–20; posterior laterals, 14–18.

The *eggs* are purplish, ellipsoidal; length, .25 mm.

On pine and other coniferous trees.

This species is held in check by an internal chalcid parasite.

Chionaspis quercus Comst.

(Oak Scale.)

Scale of Female.—Long, narrow at anterior end, much widened posteriorly, quite convex. Exuviæ brownish yellow, remainder of scale white, though often appearing gray from dust and hairs from the stem to which the scale is attached.

Body of Female.—The last segment with the anterior group of spinnerets consisting of about 10, the anterior laterals of from 17–20, and the posterior laterals of from 10–18.

This species is peculiarly characterized by having an undivided lobe on the meson; this lobe is large and rounded distally. The second and third lobes of each side are very small and are laterad of small incisions in the margin of the segment. In each case there is a reniform thickening of the body wall bounding each incision anteriorly. There is also a similar incision with a rudimentary lobe and reniform thickening of the body wall about midway between third lobe and the penultimate segment. The plates are inconspicuous and spine-like; there are usually one or two laterad of second ventral spine, two or three between third and fourth lobes, and usually five between fourth lobe and penultimate segment. The penultimate and antepenultimate segments bear six each; those on the latter are much expanded at the base.

The spines are long and conspicuous; those on the dorsal surface are situated as follows: One on each side at the base of the lateral margin of median lobe, one laterad of each of the second and third lobes, and a fourth one near the center of the anterior group of plates. Those on the ventral surface are as follows: A short one nearly ventrad of the first dorsal spine, a large one laterad of each of the second and third dorsal spines, and a fourth one a little cephalad of the fourth dorsal spine.

Scale of Male.—The scale of the male is snow-white, with the larval skin very light yellow. The texture of the scale is quite loose and the carinæ prominent. Length, 1.25 mm.

The adult male is as yet unknown. Pupæ mounted in balsam are bright yellow in color, with eyes purplish black. Fully grown male larvæ in balsam are yellowish brown.

On white oak (*Quercus lobata*). The females occur on the bark of small limbs; the males on the leaves.

Chionaspis wistariæ Cooley.

Scale of Female.—Length, 1.8 to 2.3 mm. Plainly broadened posteriorly, rather thin in texture, dirty white in color. Exuviæ .8 mm. long, brown.

Female.—Median lobes larger and more conspicuous in proportion to the other lobes than is usual in this genus; usually parallel in general direction, though sometimes slightly divergent; rounded or indistinctly pointed at the extremities, firmly united at their bases, the chitinous thickened process which unites them extending anteriorly for a distance about equal to the length of the lobes. Second pair distinct and entire, but much smaller than the median pair; outer lobule smaller than the inner. Third pair usually obsolete, but sometimes represented by low serrate prominences. The gland-spines are arranged as follows: 1, 1, 1, 1, 1–2, 2–4. The first one is short and blunt, scarcely surpassing the median lobes. Second row of dorsal gland-orifices represented by the anterior group of 2–3 orifices. Third row with 3–4 orifices in the anterior and 4–5 in the posterior group. Fourth row with 3–4 orifices in the anterior and 4–6 in the posterior group. Median group of circumgenital gland-orifices, 8–15; anterior laterals, 19–31; posterior laterals, 13–23.

Scale of Male.—Length, about 1 mm. Sides nearly parallel, distinctly tricarinate. Exuviæ yellowish brown, occupying about one third of the length of the scale.

On wistaria from Japan. (In quarantine.)

Of the seven species of *Chionaspis* found in California no single species is considered a real pest. *C. ortholobis* may be found the most plentiful, but the host plant is not of much commercial importance. As to the others, they are, in a majority of cases, held in check by parasites. At times *C. pinifoliæ* gets a good start on the pines, but is soon overtaken by the parasite.

Howardia biclavis Comst.

(Mining Scale.)

Scale of Female.—Very nearly circular; the exuviæ are marginal, and project beyond the edge of the scale.

Female.—The characters presented by the last segment of the female are as unusual as those presented by the scale. The pores on the dorsal surface of the segment are very small. Scattered over the ventral surface are numerous minute spines. The groups of spinnerets are wanting. The mesal lobes are large, oblique, nearly twice as broad as long; approximate at the base; the mesal margins diverge slightly, distal margin serrate; mesa-distal angle rounded and produced into a lobule. The second lobe is very small, being simply an angular projection of the body wall. The third lobe is about three times as wide as the second lobe; but it projects only a little beyond the margin of the segment. The plates are simple and spine-like. There are two minute ones between lobes; two between first and second lobes; two or three between second and third lobes; a group of three or four larger ones laterad of third lobe; and another group of four or five still larger ones about midway between this group and the penultimate segment. Each of the three segments preceding the last bears on each lateral margin about seven plates. Two spines accompany each group of plates, one on the dorsal surface and one on the ventral. The first and second spines of each side are very small; the third, which is between the second and third lobes, is the largest; the fourth and fifth are successively smaller. There are two conspicuous club-shaped organs which appear like thickenings of the body wall, but which are really within the body cephalad of the mesal lobes. These organs are about three times the length of the mesal lobes; they converge caudad, and the cephalic end of each is suddenly enlarged. This species may be distinguished from any other known American coccid by the presence of these organs.

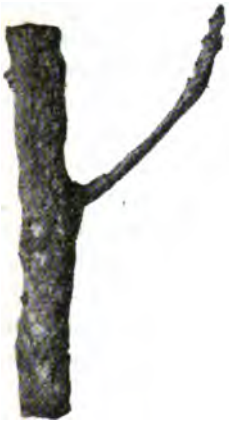


FIG. 22. *Howardia biclavis.* (Mining Scale.)

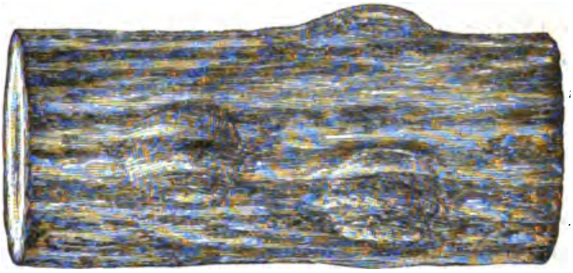


FIG. 23. Section of branch showing the mining habits of the scale. Greatly enlarged.

This scale is not to be found in California. Occasionally it is met with at quarantine, but is never permitted to pass, as the plant upon which it is found is immediately burned. At one time 325,000 orange trees infested with this and other scales were burned at quarantine at the port of San Pedro, and probably it was owing to this fact that it has been accredited as "Habitat: California."

Diaspis bromeliæ Kern.

(Pineapple Scale.)

Scale of Female.—Circular, with the exuviæ nearly marginal. The scale is white; the exuviæ are very light yellow. The first larval skin is usually naked; the second covered with a delicate film. Diameter of scale, 2 to 2.4 mm.

Female.—The body of the female is broadly ovate in outline; it is variable in color; it is usually a pale dirty yellow, with a faint tinge of purple; some are whitish yellow, with irregular pale-purplish markings;

and others are of a reddish-yellow tint. The last segment presents the following characters: The mesal group of spinnerets consists of from 9–15, usually 10 or 11; the cephalo-laterals, of from 20–27, usually 23; the caudo-laterals, 15–23, usually 16 or 17. The mesal lobes are small, separated at their base by at least the width of one of them, and divergent. The second and third lobes of each side are deeply bifurcated, with the lobes divergent; in each case the lateral lobule is more rounded than the mesal one. The fourth lobe is present, but much less developed than the other lobes; the lateral margin of this lobe is serrate.

The plates are simple and pointed. There are four or five plates, subequally distant from each other, between the fourth plate and the penultimate segment.

The spines on each side of the ventral surface are situated as follows: First mesad of the first lobe; second, third, and fourth laterad of the second, third, and fourth lobes, respectively; and the fifth between the seventh and eighth plates. All the ventral spines are very minute except the first pair, which are very conspicuous.

Of the dorsal spines the first is very delicate and is situated laterad of the first lobe; the second is large and is on the second lobe near its lateral margin; the third and fourth are laterad of the third and fourth lobes, respectively; and the fifth is about midway between the sixth and seventh plates.

Between the fifth and sixth plates there is a triangular prolongation of the body which bears an elongated pore. The penultimate and antepenultimate segments bear plate-like spinnerets.

Eggs.—The eggs are yellow; those recently deposited are paler than those ready to hatch.

Larva.—The recently hatched larvæ are orange yellow, with the eyes dark purplish.

Scale of Male.—The scale of the male is strongly tricarinated; the exuviæ are yellow.

On pineapple. (In greenhouses.)

This species has been reported from quarantine, on pineapples (fruit) from the Hawaiian Islands. It was also observed on growing plants in greenhouse.

Diaspis caruelii Targ.

Scale of Female.—Circular, snowy white, with the exuviæ central, naked and yellow. Diameter of scale, 1 to 1.5 mm.

Female.—Body yellow, circular, slightly elongated posteriorly. The last segment of the body presents the following characters: The anterior group of spinnerets consists of about 8, the anterior laterals of from 10 to 16, and the posterior laterals of about 8. There are four lobes, which are nearly in a straight line, the end of the body being truncate. These lobes are quite small, rounded posteriorly and equally distant from each other. The second lobe of each side is deeply incised, but the lateral lobule is very small, and in many cases concealed by the margin of the segment. Each lateral margin of the segment is divided into three subequal, more or less distinct lobes; each lobe ends posteriorly in one or more lobules, each of which bears an elongated pore on its dorsal surface. The plates are short, and in some cases subtruncate at extremities; they are situated as follows: Two between median lobes; two inconspicuous ones laterad of first lobe of each side; two laterad of second lobe; usually one on the anterior part of the first lobe of the lateral margin; one or two near the middle of the second lobe of the lateral margin, and two or three on the third or anterior lobe of the lateral margin. Dorsal spines: One on first lobe near lateral margin; one on lateral lobule of second lobe; and one a short distance mesad of the mesal plate of each of the three lobes of lateral margin. The ventral spines accompanying the first and second lobes of each side are obsolete. There is one at the base of the plate of the first lobe of the lateral margin; one between plates of second lobe, and one near the middle of the third or anterior lobe of the lateral margin.

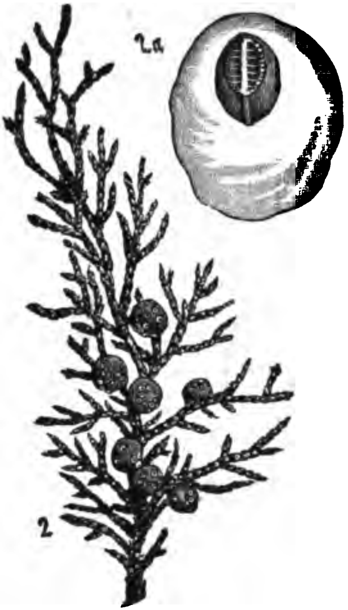


FIG. 24. *Diaspis carueli* (Juniper Scale). 2, adult females and larvæ on branches; 2a, female, greatly enlarged.

Scale of Male.—The male scale is white, and very small, being only 1 mm. in length; it is elongated, with a prominent median ridge; the larval skin is naked and light yellow in color.

Male.—Color of body light orange yellow, thoracic band yellow. The terminal joints of the antennæ are enlarged.

On juniper (*Cupressus* sp.).

In several sections this scale may be found very abundant upon juniper, but seems to confine its attack to this host plant and *Cupressus* sp. It is not considered as troublesome.

Aulacaspis rosæ Bouche.

(Rose Scale.)

Scale of Female.—Circular or irregular, snowy white, sometimes with yellowish tinge; 2.3 mm. in diameter; exuviæ sublateral; first larval skin naked, showing the segmentation; second covered.

Scale of Male.—1.25 to 1.5 mm. in length; white and tricarinated.

Female.—Body elongated; the antepenultimate segment prominently lobed and bearing 8 to 10 gland-spines. Median lobes large, approximated at base, serrulate, diverging, attached to body for entire length. Inner lobules of second, third, and fourth lobes rounder and larger than the other lobule. Fourth lobe nearly obsolete. There is a gland-spine laterad of each of the four lobes, and 2 to 4 near penultimate segment, enlarging as they are farther removed from the meson. On the dorsal surface the spines are situated as follows: one very small one on the median lobe, and one slightly larger on the outer lobe of the second, third and fourth lobes respectively, and one about three fourths of distance to penultimate segment. The spines on the ventral surface are slightly mesad of the corresponding dorsal ones. Dorsal spines in three rows; second row represented by anterior group of 2–3; third row,

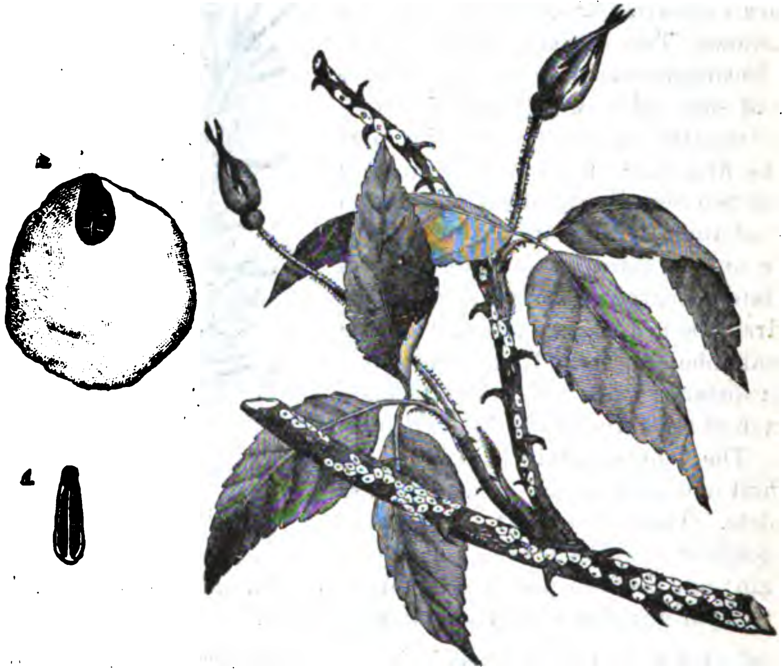


FIG. 25. *Aulacaspis rosæ* (Rose Scale). Branch showing scales on rose. *a*, male scale; *b*, female; both greatly enlarged.

anterior group 4–5, posterior group 5–6; fourth row, anterior group 4–6, posterior group 6–8. Mesad of second and third lobes respectively is an elongated pore, appearing like a lobe. Anterior group of circumgenital gland-orifices distinct, rounded, 18–22; anterior laterals, 25–32; posterior laterals, 26–34. Lateral groups indistinctly separated, sometimes almost continuous.

On rose, blackberry, and raspberry, infesting the canes.

This is a very common species in this State, and may be found on old rose bushes, and on the canes of blackberry and raspberry. In many cases it entirely coats the cane for some distance, giving it the appearance of having been whitewashed. When remedial measures are applied and all visible scale removed the horticulturist is somewhat surprised to again see the plant infested in a short time, owing to the fact that this species breed at or near the root of the host plant. When remedial measures are applied, the ground should be removed from around the base of the plant so that the wash will reach all the scale.

Hemichionaspis aspidistræ Sign.

Eggs.—Reddish fulvous. *Larva.*—Pale yellow (newly hatched).

Scale of Female.—Length, 1.8 to 2.6 mm. Distinctly broadened posteriorly and usually broadly rounded at the extremity, but occasionally bluntly pointed. Very thin and delicate in tissue or moderately thick and strong. Pale yellowish brown to brown. Exuiviæ .7 to .9 mm. long, of the same color as the secreted portion of the scale, but slightly brighter.

Female.—The first four segments anterior to the pygidium very pronounced, being often produced at each side into a conspicuous protuberance. The first and second pairs of lobes well developed, third very rudimentary or wanting. Each median lobe with three distinct notches on the outer curved edge. Lobules of the second lobe long and narrow, spatulate in form; edges thickened at the base. The gland-spines are arranged as follows: 1, 1, 1, 1, 2–5. As a rule the fifth group contains 2–3 spines, although 5 have been observed. The marginal gland-orifices between the first and second lobes, if situated on a large, conspicuous prominence. Second row of gland-orifices wholly absent. Third and fourth rows with 2–5 orifices in their posterior groups. Anterior groups absent. Median group of circumgenital gland-orifices, 5–15; anterior laterals, 15–22; posterior laterals, 17–23.

Scale of Male.—Length, 1 to 1.3 mm. Exuviæ bright yellow.

On *Aspidistræ lurida* (in greenhouses).

Epidiaspis piricola Del Guer.

This species has become quite troublesome to pear-growers in the Santa Clara Valley, and is often mistaken for the San José scale. It is easily distinguished from that species by the male scale, which in this species is of an elongated oval form and much flattened. A feeble carina extends along the middle, but the sides are not carinated. The color is white; the larval skin is light yellow and usually is about one third the length of the scale, while in the San José scale the male scale is nearly black and resembles the female scale in shape.

The female scale is circular, dark ash-gray in color, with the margin lighter, varying in color to nearly white. The exuviæ are nearly central, dark brown, naked and glossy.

This species is subject to the attack of several species of Coccinellids (ladybirds), which serve as a partial check to its increase. In some sections the lime, sulphur, and salt spray is used against this species, with good results.

A plate showing the characters of the last abdominal segment, made from specimens collected at San José, Cal., will be found on opposite page.

Aspidiotus æsculi Johns.

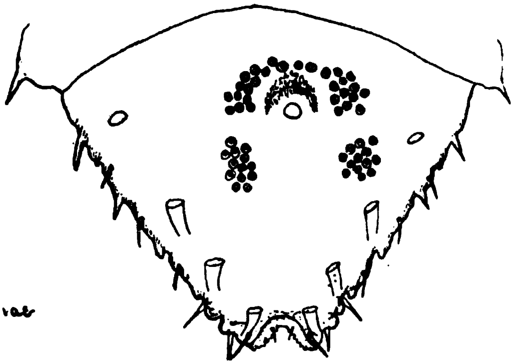
Scale of Female.—Circular, rather convex; diameter 1.5 to 3 mm.; color, dirty gray, conforming to color of bark; exuviæ a little to one side of center, and covered with excretion. In rubbed specimens the protuberance indicating the position of the exuviæ is orange-red and surrounded by a band a little darker in color than the rest of the scale; ventral scale delicate white, adheres to the bark.

Scale of Male.—Elongate oval; 1 to 2 mm. long and half as wide; darker than the female. Larval scale marked by a nipple-like prominence between the center and the anterior margin; this is usually covered with a slight excretion, but when rubbed it is orange-red. Ventral scale white, slightly thicker than that of female.

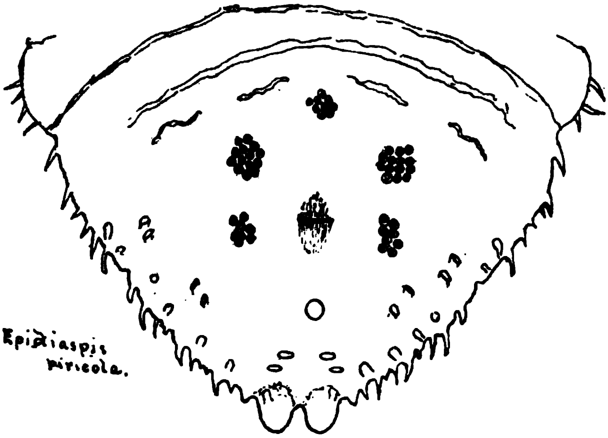
Mature Male.—Yellowish; eyes and antennæ prominent; body stout; legs long, lighter yellow than rest of body; wings large; thoracic shield with band distinct and with margins indistinct in some specimens. Length, .60 mm.; style, .39 mm.

Mature Female.—Ovate, rather plump; yellow, last segment a little darker yellow. Four groups of spinnerets, number in each group extremely variable; anterior laterals, 5–17, average 10; posterior laterals, 4–11, average 7; number variable on opposite sides of same individual; one pair of lobes, nearly as broad as long, notched on lateral margin near the tip. Plates simple and inconspicuous, one usually just laterad of the lobe and two between the second and third spines. Spines prom-

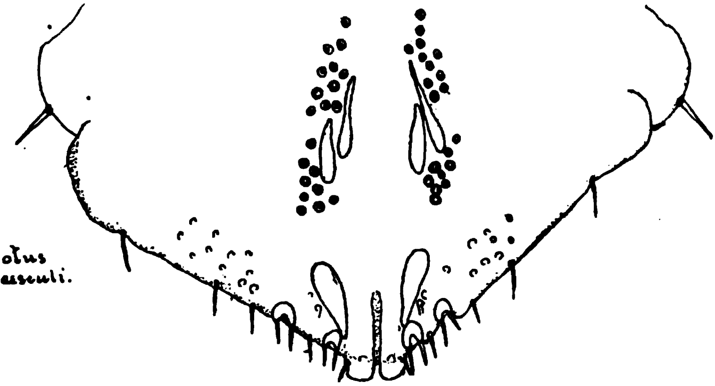
PLATE VI.



Fiorinia fioriniae



Epidiaspis piricola.



Aspidiotus aesculi.

C. T. P., del.

DETAILS OF CALIFORNIA COCCIDÆ.

inent, usually one pair to each segment, a rather deep incision just laterad of the lobe; anal opening about twice as distant from the base of the lobes as the lobes are long; spinnerets grouped about curious club-shaped organs.

On *Æsculus californica.*

Aspidiotus hederæ Vall.

(Oleander and Lemon Scale.)

Scale of Female.—Flat, lightish or light gray in color, and with exuviæ central or nearly so; exuviæ dull orange-yellow; the first skin usually showing the segmentation distinctly, the second skin more or less covered with secretion, often appearing only as an orange-colored circle surrounding the first skin. Ventral scale a mere film applied to bark of plants. Diameter of fully formed scale, 2 mm.

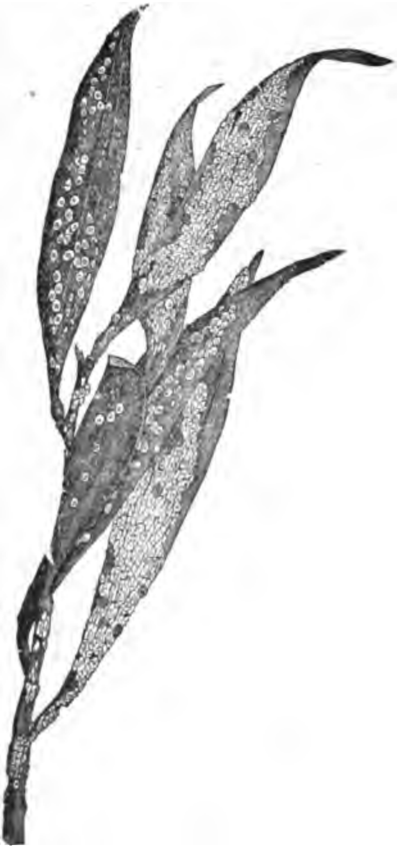
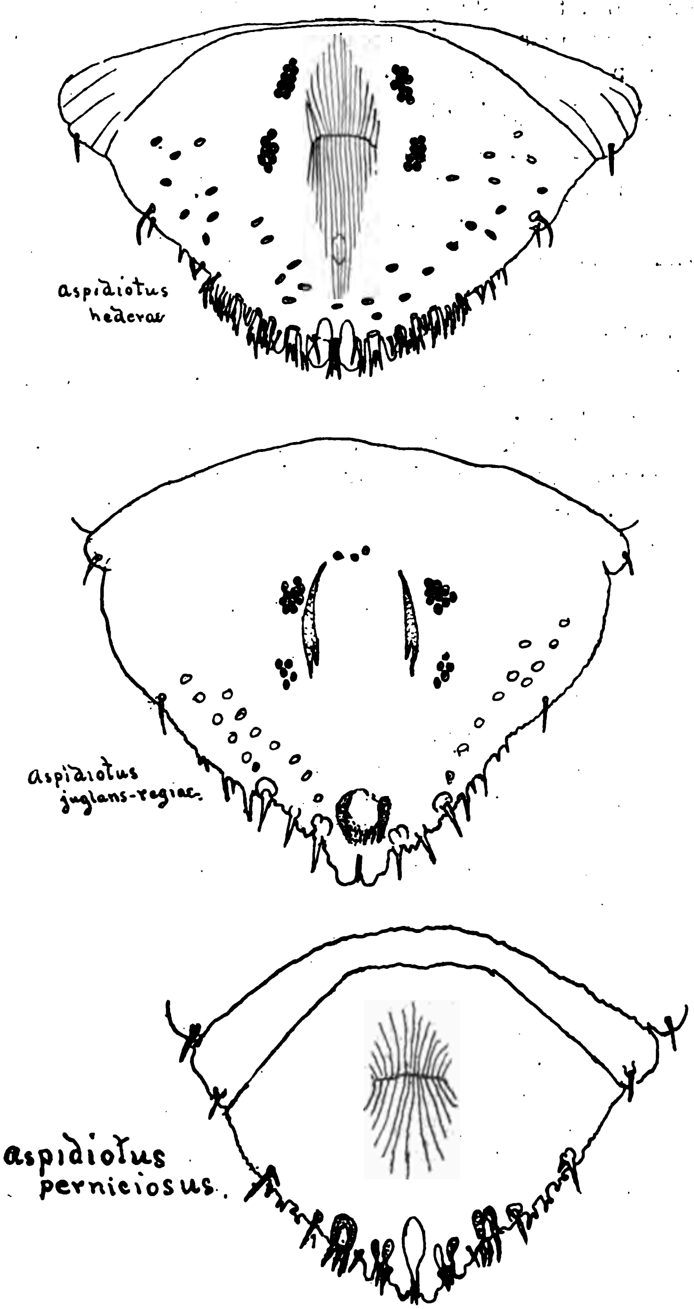


FIG. 26. *Aspidiotus hederæ* (Oleander Scale). On branch of oleander, showing leaves thickly infested.

Female.—Body of adult nearly circular, with abdominal segments forming a pointed projection; light yellow in color, mottled with darker yellow; the last segment presents the following characters: The anterior lateral group of spinnerets consists of about 9, and the posterior laterals of about 7. There are three pairs of lobes; the first and second are well developed, the third quite small. The plates are well developed; they are long and usually fringed; there are two small ones between the median lobes; those of each side are as follows: Two between the first and second lobes; three between second and third lobes; and usually seven laterad of the third lobe, of which usually four are fringed and three simple. The number of the last-named group varies from four to nine. There is on each surface of the segment a spine accompanying each lobe; one between the fourth and fifth plates laterad of third lobe, and one at



C. T. P., del.

DETAILS OF CALIFORNIA COCCIDÆ.

about one third the distance from this spine to the penultimate segments. In each case the spine on the ventral surface is a little laterad of the one on the dorsal surface.

Eggs.—Very light yellow in color.

Scale of Male.—The scale of the male is slightly elongated, with the larval skin nearly central; it is snowy white, with the larval skin light yellow. Longest diameter, 1 mm.

Male.—Yellow, mottled with reddish brown; central part of thoracic band reddish.

On oleander, magnolia, ivy, palms, etc.; also on lemons.

This is another of the common species of the State, having quite a range of host plants. It does not confine its attack to plants in the greenhouses, but is met with in many places in the open. It also attacks the lemon, usually infesting the fruit only; in such cases all the fruit on the tree is removed, either fumigated or destroyed, and the pest usually controlled.

Aspidiotus juglans-regiæ Comst.

(English Walnut Scale.)

Scale of Female.—Circular, flat, with the exuviæ laterad of the center; it is of a pale grayish brown color; the exuviæ are covered with secretion; the position of the first skin is indicated by a prominence which is pink or reddish brown. The ventral scale is a mere film which adheres to the bark. Diameter of scale, 3 mm.

Female.—The color of the female when fully grown is pale yellow, with irregular orange-colored spots; oral setæ and last segment dark yellow. This segment presents the following characters: There are either four or five groups of spinnerets; the anterior group is wanting or consists of from 1 to 4 spinnerets; the anterior laterals consist of from 7 to 16, and the posterior laterals of from 4 to 8.

There are two or three pairs of lobes. The median lobes are well developed, but vary in outline; the second lobe of each side is less than one half as large as the median lobes, elongated, and with one or two notches on the lateral margin; the third lobe is still smaller and pointed, or is obsolete.

There are two pairs of incisions of the margin, one between the first and second lobes of each side, and one between the second and third lobes. They are small, but are rendered conspicuous by the thickenings of the body wall bounding them.

The plates are simple, inconspicuous, and resemble the spines in form. The larger ones are situated one caudad of each incision.

The spines are prominent, especially those laterad of the second and third lobes; the fourth spines are a little nearer the first lobes tha[illegible]he penultimate segment; and the fifth are near the penultimate seg[illegible]; there is also a spine at or near the union of the last two segments.

Scale of Male.—The scale of the male resembles that of the female in color; it is elongated, with the larval skin near the anterior end; this skin is covered by excretion, but its position is marked by a rose-colored prominence, as in the scale of the female; the anterior part of the scale is much more convex than the posterior prolongation, which is flattened. There is a rudimentary ventral scale in the form of two narrow longitudinal plates, one on each side of the lower surface of the scale. Length, 1.25 mm.

On English walnut, infesting the larger limbs, usually on the under side.

Aspidiotus perniciosus Comst.

(San José Scale.)

Scale of Female.—Circular, slightly convex, 1 to 2 mm. in diameter; gray or dark gray, except the prominent, covered, pale or reddish yellow exuviæ. The exuviæ are nipple-like, with a shallow, depressed ring about them, which is quite characteristic of this species.

Scale of Male.—Black in color, rather convex, with the nipple-like prominence and depressed ring still more noticeable than in the female.

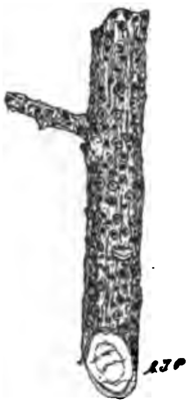


FIG. 27. *Aspidiotus perniciosus* (San José Scale).

Female.—Two pairs of lobes well developed. Median lobes prominent, rounded at the apex, notched on the outer margin near the middle, though somewhat variable and converging. The thickened inner margins of the median lobes extend anteriorly, encircling the anal orifice in a characteristic manner. The second lobes are smaller and narrower, though distinct, quite close to the median, notched on the outer margin, pointed and converging. Between the median lobes and bounding each incision of the segment are club-shaped, chitinous processes; the inner usually the larger. There are two conspicuous plates between the median lobes, two caudad of the first incision, and three small, laterally serrate ones caudad of the second incision. Often laterad of second incision are wide, furcated extensions of the margin of the segment. The spines of the ventral surface are situated laterad of the corresponding dorsal spines at the bases of the first and second lobes; the third pair laterad of second incision; the fourth pair at one half the distance to penultimate segment. Groups of circumgenital gland-orifices are absent. Rows of [illegible] spines are not prominent, though variable.

On apple, pear, peach, quince, apricot, plum, hawthorn, rose, currant, raspberry, etc.

This scale is known the world over as the San José scale, yet it is a fact that it is very scarce at San José or in the district surrounding that city. At one time this species was extremely troublesome in California, but the internal parasite *Aphelinus fuscipennis* has done such excellent work that it is not a pest in California any more. We also have several species of Coccinellids (ladybirds) that prey upon it and have materially assisted in the work of controlling this once serious pest.

Aspidiotus rapax Comst.

(Greedy Scale.)

Scale of Female.—Very convex, gray, almost white, translucent, appearing yellow because of insect beneath; the sub-central exuviæ marked by a brown or black dot and a concentric ring. Ventral scale snow-white and usually entire.

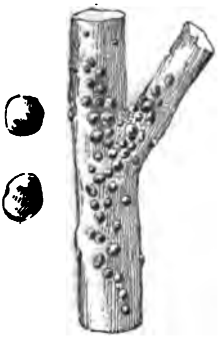


FIG. 28. *Aspidiotus rapax.* (Greedy Scale.)

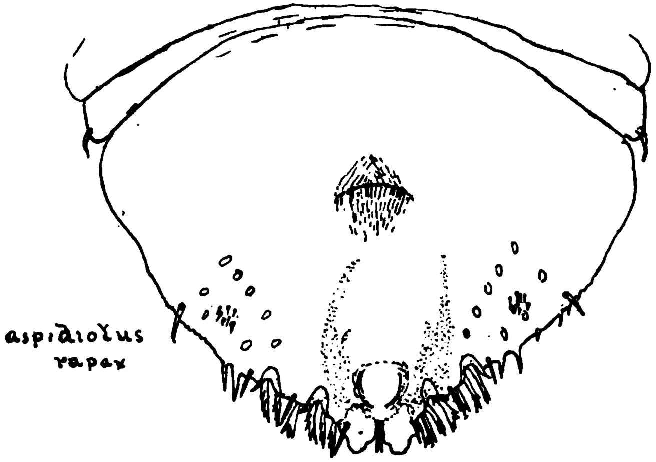
Scale of Male.—Similar to scale of female; scarcely so convex, with exuviæ sublateral.

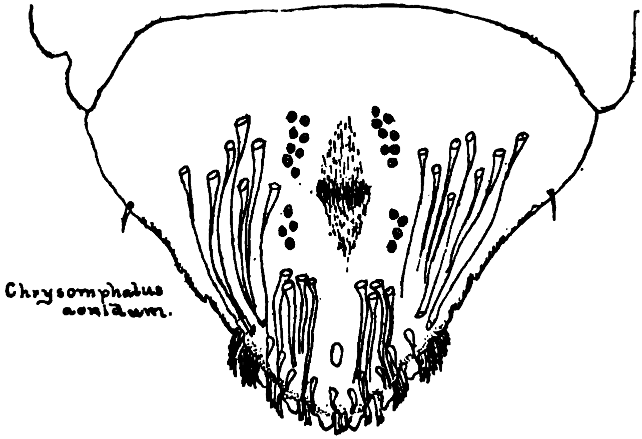
Female.—Only median lobes well developed and prominent, sharply notched on either side, the mesal notch near the apex. Second and third lobes are represented by small, pointed projections on the margin. A deep incision laterad of the median and second lobes, bounded by subequal chitinous processes. Two irregular toothed or branched plates caudad of each incision, with a simple one between them and two or three simple or furcated ones laterad of the third lobe. On each surface, spines are located at the lateral basis of each lobe; the fourth spine at about two thirds of the distance to the penultimate segment. The ventral fourth spine is slightly laterad of the corresponding dorsal spine. Groups of circumgenital gland-orifices absent. Dorsal pores in two or three irregular rows; the second of about six; the third of about four. The anal orifice is very large.

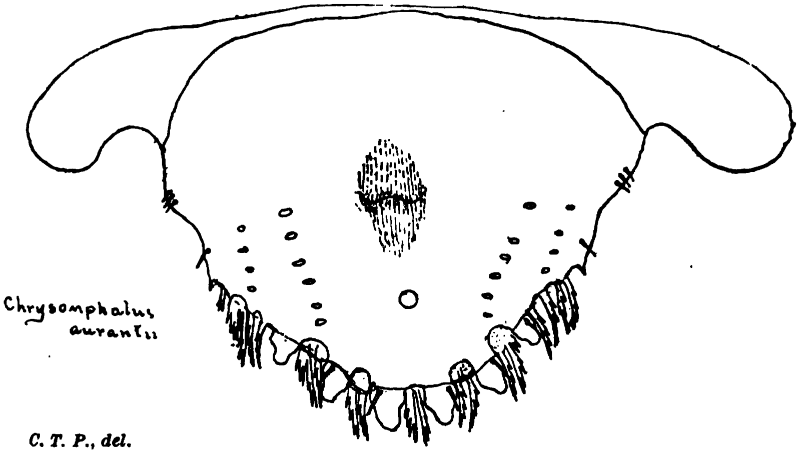
On willow, holly, ivy, acacia, orange, pittosporum, camellia, palms, etc.

This species is commonly known as the greedy scale, and it is well named, as it certainly seems to have no choice as to host plant, but thrives on almost any one of our shrubs. An internal parasite is par-

PLATE VIII.







C. T. P., del.

DETAILS OF CALIFORNIA COCCIDÆ.

tially effective against it in this State, but does not do good enough work to be of much use. This species is distributed all over the State, and while it is troublesome to individuals, yet it has not attacked any of our commercial trees or plants extensively enough to be really considered of much economic importance.

Pseudaonidia duplex Ckll.

Scale of Female.—The female scale is about 2⅔ mm. in diameter, subcircular, moderately convex, dark blackish brown, with the large round exuviæ nearly to one side, and orange in color. When upon the stems and larger twigs of the camellia the scale has the same brown color of the bark and is easily overlooked. When removed the scale leaves a white patch on the branch.

Female.—Pale orange, broadly oval or subcircular, with the large cephalic portion separated from the rest by a deep suture. Mouth parts large; skin on dorsum very strongly, transversely grooved, the grooves linear, often anastomosing. Four groups of ventral glands in the usual situation; caudo-laterals of 28 to 30, cephalo-laterals of 42; median group represented by two orifices, not very close to each other. Besides these groups there is a group of 17 to 22 orifices, quite similar in character, on each side of the mouth parts; these groups are oval in outline. The anus is about on a level with the anterior ends of the caudo-lateral groups. There are four (two on each side) long tubes or ducts originating about the region between the caudo-lateral groups and the anus, and passing hindward, practically parallel, to the end of the body. On the dorsal surfaces the segments are marked by rows of oval pores. The pygidium shows on the dorsal surface a very distinct lattice-work, as in *A. theæ* and *Ischnaspis filiformis.* Median lobes very large, brown, rounded at the ends, but notched on each side so as to be trilobed; the lateral lobes very small and passing into the straight parallel sides. The median lobes are very close together, but distinctly separated, not touching, not diverging. There are three other pairs of lobes, small, narrow, rounded at ends, very inconspicuous and easily overlooked among the scale-like plates. Plates not extending beyond lobes, scale-like, not separately distinguishable, but forming a continuous fringe, which rapidly narrows beyond the fourth lobe, and ceases before the deep notch which indicates another segment. Margin cephalad of fourth lobe distinctly serrate, serrations coarse.

On *Camellia japonica* (in greenhouses).

Chrysomphalus aonidum Linn.

(Florida Red Scale.)

Scale of Female.—Circular, moderately convex, smooth; dark olivaceous brown or reddish brown, paler at margin. Pellicles reddish yellow, always partially obscured by a layer of secretion, which is reddish brown above the first, and pale olivaceous above the second pellicle. In the center of circular raised disk is usually exposed, the secretionary covering being here worn off. In young specimens the center is covered by a raised patch of opaque white secretion. The first pellicle convex above; the second often slightly concave; the form may best be observed from the inside of the scale, where the exuviæ are more fully exposed. Ventral scale obsolete. Diameter, 1 to 2 mm.

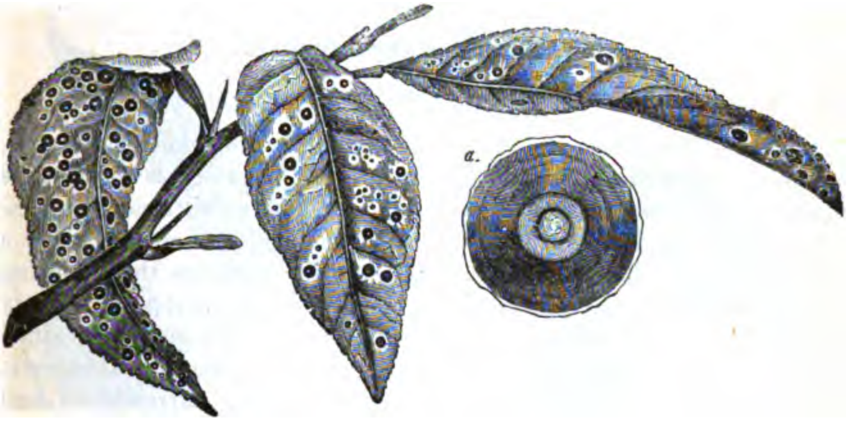


FIG. 29. *Chrysomphalus aonidum* (Florida Red Scale). On orange twig. *a*, female, greatly enlarged.

The *male puparium* is dark brown, with pale gray margins. Pellicle reddish fulvous. Length, .8 mm.

Adult Female.—Yellow, or white mottled with yellow. Body broadly rounded in front, tapering suddenly to a point behind. On the margin of the mesal thorax is a small thickened patch bearing a stout thorn-like spine. Pygidium with six prominent lobes subequal in size, each notched on the lateral edge. At a short distance beyond the lobes the lateral margin is thickened and projecting, with minute serrations and two deep indentations. Plates deeply fringed; two in the mesal and first spaces, three in the second space, and three beyond the third lobe, these last being bifurcate and fringed on their lateral edges. Circumenital glands in four groups; lower laterals with 2 to 4, upper laterals with 6 to 8 orifices. A large number of conspicuous tubular spinnerets, varying from the filiform to the trumpet-shaped type, some opening by inconspicuous dorsal pores in two series on each side, others opening on to the margin near the extremities. Anal aperture small, close to extremity; genital aperture between the upper and lower groups of glands. Length, .8 to 1 mm.

Adult Male.—Orange yellow in color, with dark brown conspicuous transverse band crossing the thorax in front of the scutellum.

Eggs and young larvæ yellow.

On palms (in greenhouses).

Chrysomphalus aurantii Mask.

(Red Scale of California.)

Female.—The female is light yellow in color in the adolescent stages, becoming brownish as it reaches maturity. When fully developed the thorax extends backward in a large rounded lobe on each side, projecting beyond the extremity of the abdomen, and giving the body a reniform shape. The last abdominal segment presents the following characters: Three pairs of well-developed lobes, the first pair abruptly narrowed at about half their length; the notch on the mesal margin is often nearer the distal end of the lobe than that of the lateral margin. The lobes of the second and third pair are abruptly narrowed at half their length on the lateral margin, and often bear a notch on the median margin near the distal end. Laterad of the most lateral plate is a triangular lobe on the margin of the segment, which is separate.

The plates are deeply fringed; those between the first pair of lobes on their distal margins, the others on their lateral margins. They are all well developed, exceeding the lobes in length, and are situated as follows: Two between the first pair of lobes, two between the first and second lobes of each side, two between the second and third lobes, and three between the third lobe and the lobe on the margin of the body. The first plate laterad of the second lobe and the three plates laterad of the third lobe are each deeply bifurcated, and each bifurcation is fringed on the lateral margin.

On the ventral surface there is a spine near the base of the lateral margin of each of the four lobes except the first; there are also about three small slender spines on the margin of the body near the penultimate segment. On the dorsal surface there is a spine with each lobe. The first spine is very slender and inconspicuous, but as long as the lobe; it is situated at the base of the lateral margin of the lobe in such a manner that it can be moved either above or below the lobe. Each of the other spines is situated near the middle of the base of the lobe it accompanies. Female viviparous.

Scale of Male.—The scale of the male resembles that of the female, excepting that it is only one fourth as large; the posterior side is prolonged into a flap, which is quite thin; and the part which covers the larval skin is often lighter than the remainder of the scale.

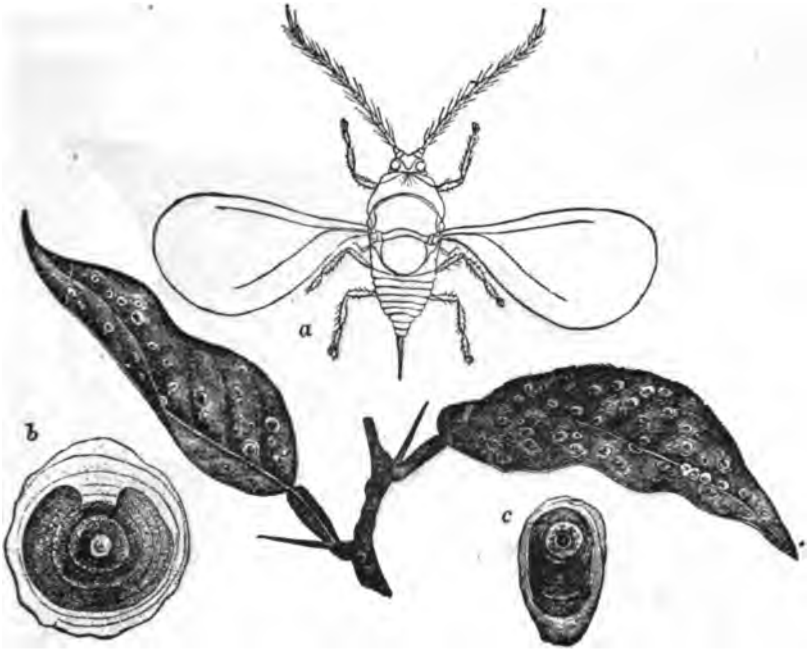


FIG. 30. *Chrysomphalus aurantii* (Red Scale). *a*, male; *b*, female scale, greatly enlarged; *c*, male scale, greatly enlarged.

Male.—The male is light yellow, winged, with the thoracic band brown, and the eyes purplish black.

On orange, lemon, grape-fruit, sago palms, rose and various palms.

While this species is called the "Red Scale of California," it is an introduced species. It is also a very serious pest in other countries, having been reported from Australia, China, Japan, New Zealand, Samoa, Fiji, Hawaiian Islands, West Indies, and many other countries, as well as several states in our own country. In California it is mostly confined to the southern part of the State, where it is well known to our citrus-growers. By strict quarantine, fumigation, and the use of various sprays it has been practically held in subjection in some of the counties, while in others it has been allowed to gain quite a foothold.

While Australia has been credited as the home of this pest, later investigations seem to show China to be the real home.

Chrysomphalus aurantii citrinus Coq.

(Yellow Scale of the Orange.)

This species differs but slightly from *C. aurantii*, but in its habits and color there is a very marked difference. The female scale is circular, with the exuviæ slightly to one side; the scale is not as convex; the margins are wider and a light gray. The body is a pale yellow; the ventral scale is light colored and remains attached to the upper one, making it difficult to remove the insect from the scale.

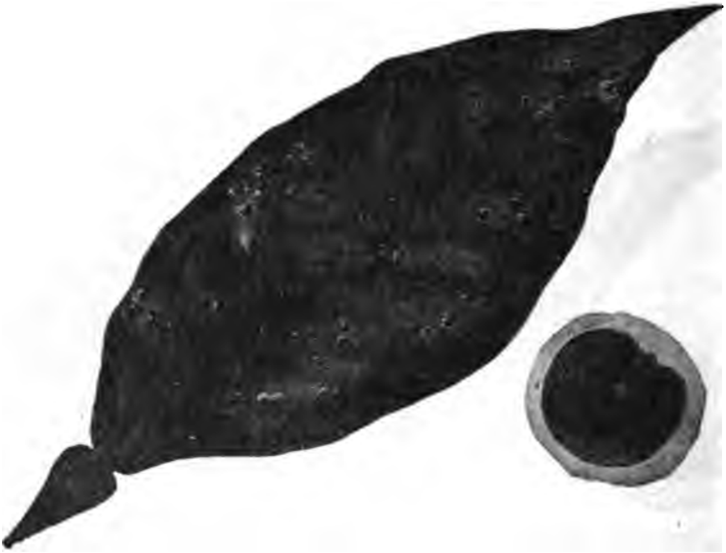


FIG. 31. *Chrysomphalus aurantii citrinus* (Yellow Scale). On orange leaf. Female, greatly enlarged.

A curious fact about this insect is that it seldom attacks the wood, even when the foliage and fruit are covered with them. On this account the fruit-grower can readily determine between it and *aurantii*, as the latter infests the young shoots and even the large branches.

On orange and lemon.

This scale was introduced into this State in 1872 and for a number of years proved to be very destructive. It is now held in almost complete subjection by its natural enemy, *Aspidiotophagus citrinus* Craw, a minute chalcid fly introduced from Japan.

Lepidosaphes beckii Newm.

(Purple Scale.)

Scale of Female.—The scale of the female is long, more or less curved, and widened posteriorly. It is brown, with the exuviæ of the same color and with a delicate margin. The ventral scale is well developed; it is white, and consists of a single piece which is slightly attached at its sides to the lower edge of the scale, and is more or less incomplete posteriorly. Length of scale, 3 mm.

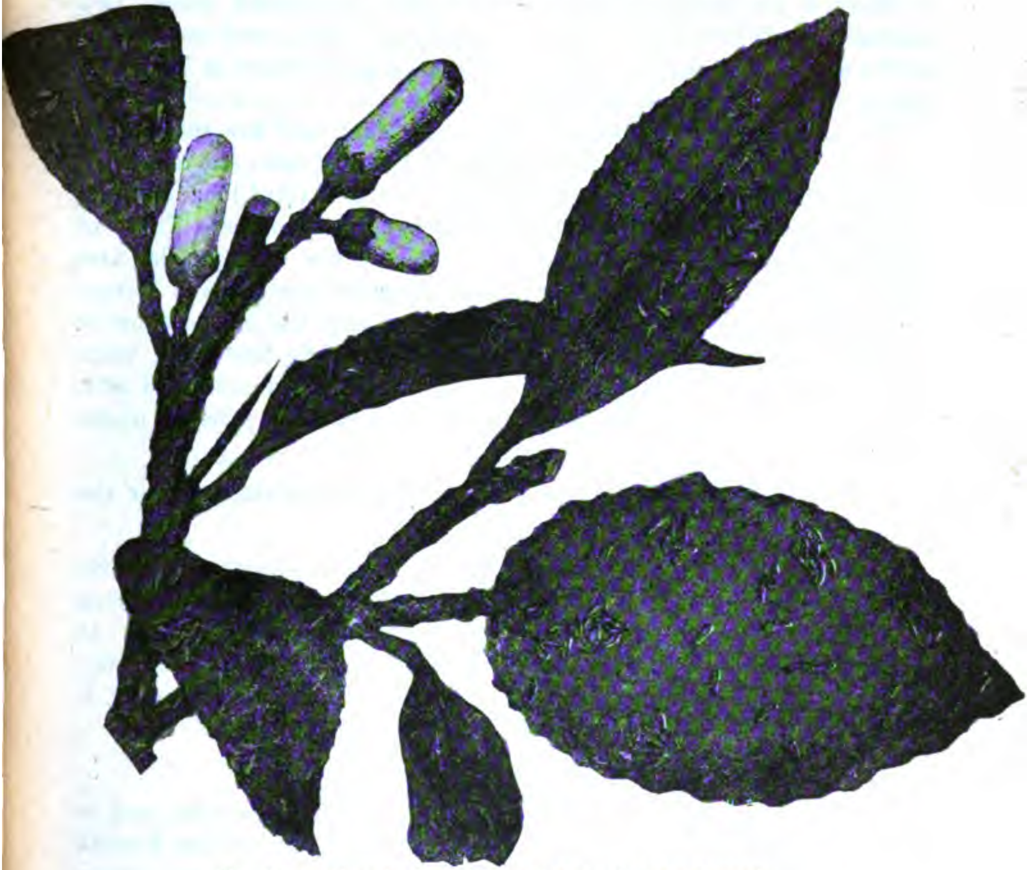


FIG. 32. *Lepidosaphes beckii* (Purple Scale). On orange branch.

Female.—The female is yellowish white. The characters of the last segment are as follows: The anterior group of spinnerets consists of about 6; the anterior laterals of about 18, and the posterior laterals of about 9.

The median lobes are well developed, with the margins crenate; the second lobe deeply incised, with the margins of the lobules either entire or crenate; the third lobe is quite inconspicuous, projecting but little beyond the body wall, the margin crenate and one large notch in the center of the lobe.

The plates are long, simple, and tapering. There are two of them in each of the following places: between median lobes; between first and second lobes; between second and third lobes; laterad of third lobe; and about midway between this lobe and the penultimate segment. There is an elongated pore between first and second lobes; two laterad of each of the third and fourth pairs of plates; and one laterad of the fifth pair of plates. The penultimate segment bears at least four plates upon each lateral margin.

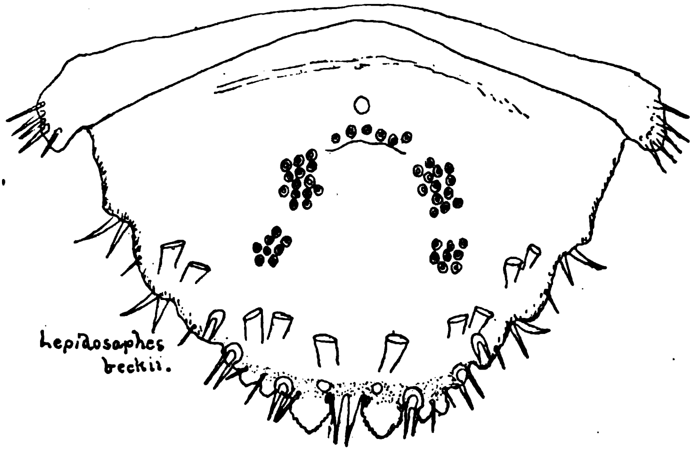
The spines upon the dorsal surface are long, and are situated as follows: one at the base of each margin of the first lobe; one dorsad of incision of second lobe; one dorsad of the notch of third lobe; and one about midway between the fourth and fifth pairs of plates. Those of the ventral surface are as follows: cephalad of the bases of the first pair of plates are two small spots which resemble the bases of spines, and are doubtless the homologues of the first pair; the second spine of each side is near the base of the lateral half of the first lobe; third spine laterad of lateral lobule of second lobe, and fourth and fifth spines between the members of the fourth and fifth pairs of plates respectively.

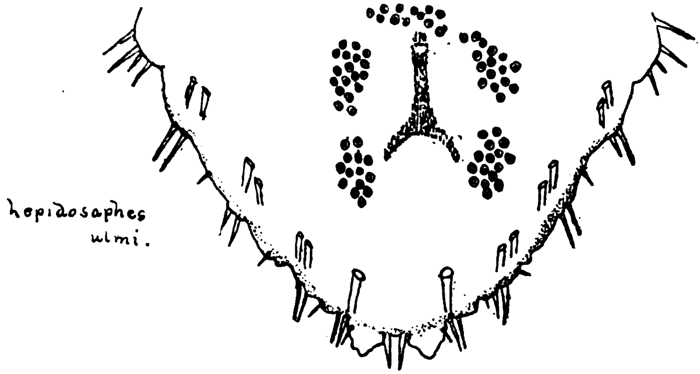
Eggs—The eggs are white, and are arranged irregularly under the scale.

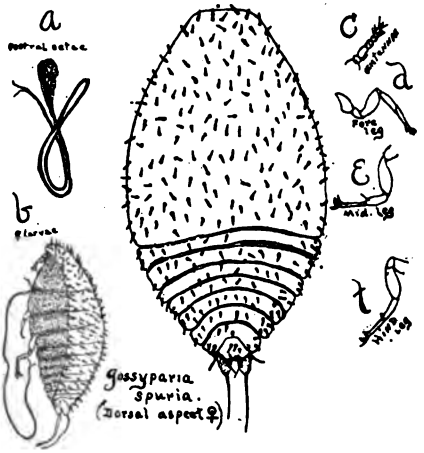
Scale of Male.—The scale of the male is usually straight, or nearly so; the same color as that of the female, or in some specimens varying to a very dark brown, almost black, the larval skin light yellow. At about one fourth of length of the scale from the posterior extremity, the scale is thin, forming a hinge, which allows the posterior part of it to be lifted by the male as he emerges. Length, 1.5 mm.

On orange, lemon, grape-fruit, sago palms.

This species is well known to many of our citrus-growers, and is commonly known as the purple scale. It was introduced from Florida on orange stock, and is to-day one of the most serious pests we have in the State. By strict quarantine it has been practically confined to certain districts, and with the use of insecticides and fumigation its spread has been checked. At the Insectary we are now working on material from which we hope to get its natural insect enemy, and if successful, our past experience in this line gives us the hope that at last we may be able to successfully control this pest.







a, rostral setæ; *b*, female larva; *c*, antennæ; *d*, fore leg; *e*, middle leg; *f*, hind leg.

C. T. P., del.

DETAILS OF CALIFORNIA COCCIDÆ.

Lepidosaphes crawii Ckll.

Scale of Female.—The female scale is narrow, measures 2¼ mm. long and ½ mm. wide; pale orange yellow; exuviæ concolorous.

Adult Female.—Yellow; four groups of ventral glands, caudo-laterals of 3, cephalo-laterals of 4 in a row. Median lobes very large, roundish at the ends, their edges finely serrate. They are closely adjacent at a point at the base, being separated, however, by a pair of small spine-like plates; thence they diverge at nearly a right angle to their rounded ends; thence rapidly sloping, the outward slope longer than the inner, and diverging from it at an angle of about 80 degrees. Next to the outer side of each median lobe is a small spine-like plate, then a sac-like incision, then the small second lobe, shaped much like the last joint of a finger, and in bulk hardly one tenth of a median lobe. Following this is a small sac-like incision, then a pointed projection, then two succular incisions, then after a short interval a spine-like plate, then another sac-like incision, then a long interval of smooth margin, then another sac, then another interval, in the middle of which is a small spine. Below the sac-like incisions are transversely elongate pores.

The scale is extremely inconspicuous, as it lives beneath the epidermis, on the under side of the leaf, along the mid-rib. By this habit, and the large median lobes, it will be readily distinguished from *M. grandilobus* Maskell, which has the large median lobes; it is known, too, by the entirely different color of the scale, etc. Several of the specimens were parasitized.

On the under side of the leaf beneath the epidermis of *Quercus cuspidatus.*

This species represents one of the smallest members of this destructive family. Its mining habits and size make it extremely difficult to detect.

Lepidosaphes ulmi Linn.

(Oyster-shell Scale.)

Scale of the Female.—Mussel shaped, more or less curved, of a purplish-brown color, with the exuviæ yellowish. Length, one sixteenth of an inch.

Adult Female.—The body is light yellow. The last segment presents the following characteristics: The anterior group of spinnerets consists of from 11 to 17; the anterior laterals and posterior laterals each of 16 to 21. The median lobes are large and wide, with the sides parallel; they are only about three fourths as long as broad. Each lobe is narrowed on each side near the distal extremity by one or two notches, and then rounded. The second lobe of each side is about as wide as the first, and is deeply incised; mesal lobule with mesal margin as long as lateral margin of the first lobe, and rounded posteriorly; lateral lobule about half the length and width of mesal lobule, and similar in shape. Third lobule obsolete. The plates are long, simple, and tapering.

Eggs.—These are white, and are arranged irregularly under the scale.

Scale of Male.—The scale of the male of this species is usually straight and of the same color as that of the female. At about one quarter of the length of the scale from the posterior extremity, the scale is thin, forming a hinge which allows the posterior part of it to be lifted by the male as he emerges. Length, .06 of an inch.

The male is translucent, corneous gray, with a dorsal transverse band on each joint, and the portions of the mesothorax and metathorax darker, or purplish gray, with the members somewhat lighter.

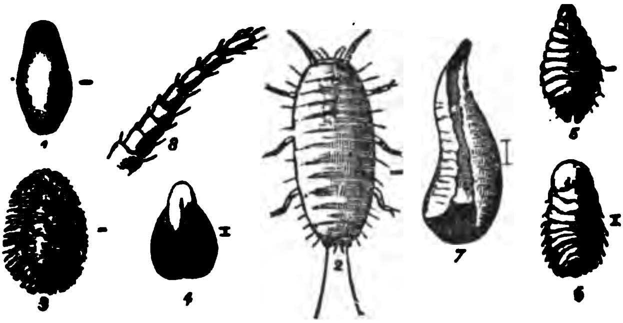


FIG. 83. *Lepidosaphes ulmi* (Oyster-shell Scale). 1, egg; 2, young insect (larva); 3, appearance of secretion as it hardens and forms shell over insect; 4, immature scale; 5 and 6, appearance of insect after casting skin, limbs, and other appendages; 7, dorsal view of insect at maturity; 8, antennæ. (All greatly enlarged.)

According to climate and locality the young scale hatch from the middle of March to June. Color, yellow. They begin to form the cottony excretion after twenty-four hours, and in from two to four days the insect is completely covered with a dense excretion, which increases as the larva grows.

On apple, pear, plum, hawthorn.

In several of the older apple orchards of the State this species can be found in limited numbers, also in the grounds of private residences where the trees are neglected. An internal parasite and predaceous insects prey on this species, causing a partial check to its increase.

Parlatoria pergandii Comst.

(Chaff Scale.)

Scale of Female.—Circular to elongated, irregular, dirty gray, 1.6 mm. in length; exuviæ marginal, brown, the first naked and the second covered by a thin skin of secretion, occupying nearly one third of length of scale.

Scale of Male.—Long and narrow, lateral margins prominent, not carinated, light gray with terminal exuviæ darker.

Female.—Three pairs of well-developed lobes, nearly equal in size, broadest near the middle, tapering anteriorly, notched deeply on each side of the apex. A rudimentary fourth lobe, produced into a papilla, halfway between third and penultimate segment. A crescent-shaped thickening of the body wall appears between the median lobes, between median and second, second and third, and two thickenings between third and fourth lobes and penultimate segment. The plates are as long as the lobes, and fringed on the distal margins; two between median lobes, two between median and second, three between second and third, three between third and fourth, and three palmate plates cephalad of fourth lobe. On the three segments preceding the last are five or six plates, each produced into a papilla. A spine on the dorsal surface of each lobe near the margin; on the ventral surface the spines are situated laterad of the second, third, and fourth lobes respectively. Four groups of circumgenital gland-orifices, each of about 7, but varying from 5 to 10.

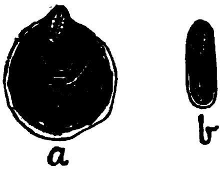


FIG. 34. *Parlatoria pergandii* (Chaff Scale). *a*, female, much enlarged; *b*, male, also enlarged.

On orange. (On palms in greenhouse.)

This is a very difficult scale to detect on the orange, being so near the same color as the bark. In California this scale has not gained a foothold, being known in the open in only two districts. The author once found in a new section thirteen trees that were badly infested, and the entire infestation was on the trunk and lower branches up to the main fork of the tree. This scale seems to prefer the lower branches and trunk and requires close inspection to detect its presence.

INSECTS OF THE YEAR.

By E. M. EHRHORN.

The season of 1906 was notable for an abundance of rain, coupled with a rather mild spring, and these conditions were very favorable to the production of an abundance of insect food. Climatic conditions have a great bearing on all pests, and abundance of food, produced by favorable weather conditions, generally acts as a stimulus for an increase of the more common species.

For many years the State departments have urged upon farmers and fruit-growers the necessity of reporting the appearance of insects and diseases as soon as noticed, so that timely advice and early applications might be made on the various pests. I am sorry to say that such recommendations in most cases have gone unheeded, for in few instances have the growers responded, and these no doubt realize that the State furnishes such advice free, through the agencies of the Horticultural Commission and the Experiment Station. Let us hope that in the future the farmers and fruit-growers will become more interested in the necessity for timely reports and in the indispensable coöperation of applied science which the State institutions are carrying on for the agricultural industry in all its various branches.

Of all the injurious insects, the ones which seem to be constantly, and with good cause, on the mind of the grower, are the scale insects, for inquiry regarding these pests are continually being received.

Brown Apricot Scale (*Eulecanium armeniacum*).—This species was reported more plentiful in several districts, and samples of badly infested twigs have been received, but it was gratifying to observe that *Comys fusca*, its parasite, was always present. It is absolutely necessary for the growers to send samples of all scale insects to the office of the Horticultural Commissioner, room 11, Ferry Building, San Francisco, for the reason that in many cases promsicuous spraying would endanger the good work of reduction, which is steadily going on by the delicate parasites and other natural enemies.

Black Scale (*Saissetia oleæ*).—Not very extensive inquiry regarding this species has been received, but very gratifying reports of the work of *Scutellista cyanea*, *Tomocera californica*, and the Rhizobiids have been received. In the more interior sections of the State the conditions need further study, as there the scale develops an even growth, *i. e.*, all individual insects produce eggs at the same period. This seems to prevent the chance for future generations of the parasites, as such conditions are not promising for a big yield of parasites. We are now looking into the problem, and no doubt we shall be able to remedy this peculiar condition in the near future, either by introducing a parasite to attack the scale at a different stage or by encouraging a later brood of scale on certain varieties of evergreen plants.

Red Scale (*Chrysomphalus aurantii*) and **Purple Scale** (*Lepidosaphes beckii*).—It may be said that the conditions of these two species are about normal. Vigorous spraying and fumigation in the various sections where they exist have made this possible. Every feasible proposition has been looked into by the State Commissioner in the furtherance of parasites for these species, and much material is now in the hands of the entomologist in charge of the Sacramento insectary.

San Jose Scale (*Aspidiotus perniciosus*).—There has been a little more complaint of the appearance of this species this season, not from the older sections, but from new localities and the mountain regions. It is possible that rain and cold weather during the spring months somewhat check the work of the parasites. As a rule we do not fear the work of this scale any longer, but we must not disregard its presence and become careless, for under favorable conditions it would not take much for the scale to increase and do considerable damage.

Pear Diaspis (*Epidiaspis piricola*).—Very little inquiry concerning this scale has come to hand. The thorough work against this hiding species, by the removal of moss and lichens, under which it secretes itself, and by spraying with caustic soda, has materially helped to check it. The twice-stabbed ladybird (*Chilocorus bivulnerus*) can be found in great numbers wherever this scale exists, and is better able to attack it after the moss is removed.

Cottony-Cushion Scale (*Icerya purchasi*).—The usual demand for *Novius* (*Vedalia*) *cardinalis* would indicate that this scale was in its normal state of existence, and it is gratifying to know that nearly every inquiry accompanied by specimens was found to harbor the ladybird in one of its stages. I sincerely believe, from past observations, that the *Vedalia* is with us to stay, and that the *Icerya* will not again be a serious pest.

Codling-Moth (*Carpocapsa pomonella*).—From reports received from the apple and pear sections of the State, it is apparent that this pest was not as abundant as was expected this season, and that the fruit is comparatively free from worms and of good quality. Much spraying with arsenites has been done in the larger sections, and this, coupled with other methods, has no doubt done much to reduce the pest. Remarkable as it may seem, we find that the pest was as scarce in outlying sections, where spraying was not carried on, as in the thoroughly sprayed orchards. The causes for all this are many. Very good reports have reached the office of the presence of *Caliephialtes messer*, the imported parasite, in goodly numbers. Many of our native parasites have also been observed quietly destroying the larvæ under loose bark and in burlap bands. The thorough destruction of the worms in the packing-houses, the picking up of fallen fruit, and the gathering of worms found under burlap bands in the orchards, without question have had a great bearing on the scarcity of this destructive pest.

Peach-Root Borer (*Sanninoidea opalescens*).—This pest was reported but a few times, and that from neglected places. Past experience has demonstrated that with eternal vigilance, clean systematic worming of trees, followed by a thorough application of good barriers, this pest can be kept down to a minimum.

Cankerworms (*Alsophila pometaria* and *Paleacrita vernata*).—The thorough application of barriers in the fall of the year has caused a great reduction of this pest. Ever since it has been demonstrated that the wingless female moth, when ready to deposit eggs, could be captured during her ascent of the tree with various substances or traps, diligent experiments have been made to find the most persistent material for the capture. Within the last three years most excellent results have been obtained by the use of tree tanglefoot, a very sticky substance which keeps its adhesive qualities for two or three months. It is advisable to apply this substance on paper bands instead of directly on the bark, and it is very important that the application be made early in the fall before the moth appears.

Peach-Moth (*Anarsia lineatella*).—This pernicious enemy of the peach should really not give any trouble, since it has been demonstrated that the winter larvæ—those hibernating in the soft bark of the crotches and larger limbs—can be completely eradicated by timely spraying with lime, sulphur, and salt, or a good kerosene emulsion, applied as late as possible in the winter—just before the buds open. Any great damage done by this pest shows the result of pure and simple neglect of the growers to avail themselves of practical demonstrations and experiments. In the past season many inquiries were received stating that this pest was doing considerable damage, especially to young trees.

Cherry-Slug (*Eriocampoides limacina*).—These dark-colored, slimy larvæ, with the head end much enlarged, somewhat resembling small slugs, which rest on the surface of the leaves and feed on the outer layer, gradually skeletonizing them, have been reported quite abundant. The pest is an easy one to control, if taken in time. As soon as the first slugs are noticed on young leaves, any of the arsenical mixtures, applied either wet or dry, will check them. Dusting young trees of moderate height with road dust, air-slaked lime, or hydrated lime, will effectually stop the ravages.

Flat-Headed Borer (*Chrysobothris femorata*).—The larvæ of this species, which are whitish grubs, with an enlarged, flattened head, found boring beneath the bark of a great variety of young trees, have been rather more plentiful this season. This species can be checked by preventing sunburn by the use of tree protectors or by whitewashing the trunks. A good remedy when the young borers are first noticed is to apply to the bark a mixture of lime and whale-oil soap at the rate of 25 pounds of unslaked lime to 6 pounds of soap.

Tussock-Moth (*Hemerocampa vetusta*).—This species has caused a lot of loss and trouble this season, not only in the fruit sections, but also in private parks and groves. The control in the orchards is only a matter of persistent effort on the grower's part to gather the egg masses in the fall at pruning time. These are so conspicuous as not to require much hunting. The collecting of the cocoons in summer, whenever practicable, is advisable, if done before the moth escapes. It is a greater task to practice these methods where evergreen shrubbery grows, but on large tree-trunks and near-by fences, where caterpillars generally web, many egg clusters and cocoons can be destroyed. Spraying with arsenites, unless done when the caterpillars are very young, has very little effect.

Tent-Caterpillars (*Malacosoma distria* and *M. californica*).—These two species aroused considerable anxiety by appearing in numbers during the early season, the pest being so numerous as to defoliate great numbers of trees. Especially was this true of *M. distria*, the more common species of the two. The burning of the tent and the destroying of congregated caterpillars on the trunks of trees at the start will stop the pest and save the loss of foliage and the injury to fruit.

Red Hump (*Schizura concinna*), **Nuttall's Sheep-Moth** (*Pseudohazis eglanterina nuttalli*), and **Brown Bear** (*Estigmene acræa*).—All these species have been reported from different localities with complaint of damage. The brown bear especially has been very abundant, doing much damage to garden plants. The red hump is reported as doing considerable damage to plum trees in two upper counties, and Nuttall's sheep-moth as defoliating prune trees in several localities. Early spraying with arsenites and later gathering the caterpillars and cocoons is about the only way to cope with these pests.

Tomato-Worm (*Protoparce sexta*) and **Vine Sphinx** (*Celerio lineata*). Both these species have been reported as appearing in numbers in various places. Owing to the habits and food plants of these large caterpillars it is very difficult at times to use arsenites, and the quickest and best method to get rid of them is to destroy them by cutting in two with a pair of scissors. Although this method might seem slow, it has been successfully performed on a large scale.

Cornworm (*Heliothis armiger*).—This species is always present, and reports received from all over the State show that there was not any great increase of its usual numbers. Owing to its life, the larva being inclosed with the ear in the husk, this insect is a very difficult one to fight, but can be checked to a certain limit by rotation of crops, or by planting catch crops.

Cabbage-Butterfly (*Pieris rapæ*).—The cabbage-worm, the larva of the cabbage-butterfly, has caused considerable damage to the cabbage crop and other crucifera. Its abundance this season was very marked, due probably to more favorable conditions. Examination of the late-brood chrysalids indicates that there will be a great reduction in the winter-brood holdovers, as fully seventy-five per cent show the attack of the parasite (*Pteromalus puparum*).

Cutworms (*Peridroma saucia*, *Agrotis ypsilon*, and others).—From reports and observations, 1906 was a banner year for these destructive pests. The early crop of weeds caused by the mild spring and abundant rains was a great inducement for a large brood of cutworms.

Oak-Tree Caterpillar (*Phryganidia californica*).—Several localities were visited by this pest, and it aroused much anxiety, for it was so numerous as to defoliate great numbers of trees. Owing to the good work of parasites, this species generally only lasts one season, and the trees have a chance to recuperate before another visitation occurs. Very little can be done when the pest does appear in numbers, as the host plants are generally too large to spray with arsenites.

Green Apple-Louse (*Aphis pomi*).—The past season has been a very favorable one for plant lice, and this species in particular was very abundant, so much so that considerable loss resulted to the crop in some sections. Of all the species attacking fruit trees this one is most difficult to handle, owing to its work of curling the leaves, thus preventing a thorough contact with spray materials; therefore, an early spraying, just as the first lice appear and before they cause the curling of the leaves, is absolutely necessary.

Woolly-Aphis (*Schizoneura lanigera*).—This pest is always to be found to a greater or less extent. During the past season much alarm was felt, as it seemed to be present in greater numbers. A great deal of this trouble could be averted if the fruit-growers would pay closer attention to the root-form. If during the fall, after harvest, a thorough campaign were instigated and every grower would undertake to treat the larger roots with gaslime, tobacco, or wood ashes, this pest could be greatly reduced. Spraying for the summer, aërial or branch form, as it is called, is not sufficient to check it, as the root-form, as soon as the growth starts, furnishes abundant material to restock the tree during the growing season.

Black Peach-Aphis (*Aphis persica niger*).—Not much complaint regarding this species came to hand. It is possible that timely warning has caused many to fight the pest, which fortunately has as yet only gained a foothold in a very small area.

Cabbage-Louse (*Aphis brassica*).—This species was exceptionally abundant, not alone on cabbages, but on other plants of this family, and caused much loss to young plants. It does not take much for this species to increase, especially when conditions are right and new vigorous plants are at hand. It is true that a great many ladybirds and syrphus-flies can be found when the pest is at its height, but these are not present in sufficient numbers in the spring to obviate the rapid increase at that time. By clean culture, the destruction of all worthless plants in the fall, and diminishing in this way the winter hibernating form, much aid is given the various enemies of this pest.

Melon-Aphis (*Aphis gossypii*).—This pest is becoming more alarming each year, despite the fact that late in the season enormous quantities of parasites, ladybirds and syrphus-flies can be found. This is probably due to the fact that when the plants begin to cover the ground it is next to impossible to use sprays of any kind. More attention should be devoted to the aphis while the plants are very small, and when the first lice are noticed spraying should be resorted to. If reduced at this period we can expect to get better help from the many enemies which attack it.

Many of our shade trees, the poplar, elm and willow, were attacked by the usual species generally found on these trees, which for some time made a very disagreeable sight of sidewalks and dooryards.

Grasshoppers.—Wherever we find arid lands in our several counties, lands which are generally used as stock pasture in the spring of the year, we must always be prepared to hear of grasshopper damage. This season was, so to speak, an off year for grasshoppers. These insects continue to make periodical invasions, and these have proven that grasshoppers are capable of doing enormous damage, and also that if this pest is not taken in hand before its wings develop, all the efforts available will not give much relief. Grasshoppers lay their eggs in the ground in the fall of the year, and if the ground remains undisturbed the eggs hatch in the spring, when favorable weather prevails. We seldom find the young hopper in swarms in our valleys, owing to the fact that the eggs of the migratory insects, those which came to us from the arid uplands or pastures, have generally been destroyed by plowing or cultivating. We know that to have grasshoppers we must have a mild winter, and we must expect the pest to migrate from undisturbed lands to our cultivated areas when their natural food pastures dry up. We often note the decrease in numbers in the breeding grounds, and we are told that this is caused by climatic and soil conditions, but too few observations have been made in California to substantiate this claim. There is no doubt that the grasshopper plague can be easily controlled, for the breeding areas are comparatively small. It is necessary for the grower to closely observe the first appearance of young hoppers, and the fight will be of short duration. Most complaint of damage comes when the grasshopper is on the wing, generally in the months of June and July, and it is at this time that very little help can be given. Poison baits and hopper-dozers are not necessary if the breeding grounds are closely watched in early May. The hauling of hay to the barns from the fields to which hoppers have migrated brings them to the orchard and garden, and frequently much damage is done. This should be avoided if possible.

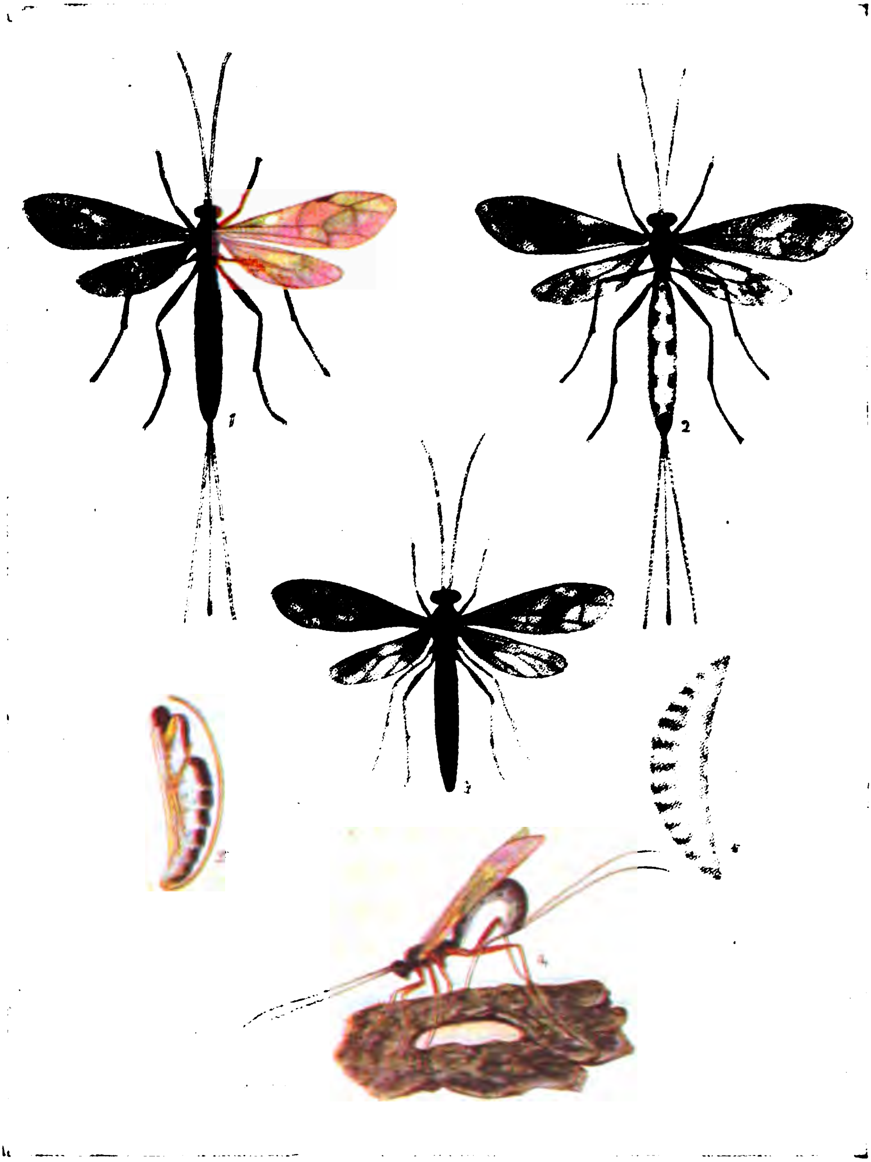
Vine-Hoppers (*Erythroneura comes*).—No perfectly satisfactory method has as yet been devised to keep this hopper in check. In some seasons not much damage is done, owing to the limited numbers found. This was the case in the season of 1905, but 1906 found an abundance of hoppers doing considerable damage to the vines. The gathering of all rubbish and dead weeds, in which this species hibernates, and removing these from the vineyard, will do much to reduce the pest. *Tettigonia circellata*, which at times does considerable damage, was only found in small numbers.

Pear-Thrips (*Euthrips pyri*).—This species, although present in the several areas reported from in 1904 and 1905, was not near as abundant during the past season. From reports at hand, we find that probably climatic conditions are partly the cause of this reduction, but the fungus which is found attacking this species no doubt does its share. It will be necessary to continue observations and experiments on this species, as no thorough method of control has as yet been found.

Red Spiders and Mites.—Of the members of this family it may be said that the pear-leaf blister-mite (*Phytoptus pyri*) was very abundant, while the yellow mite (*Bryobia* sp.) was not quite as prevalent as last season. Of the other species very little complaint reached this office, and from general reports these have not caused any material damage.

Ants.—A great amount of inquiry regarding the appearance of ants in houses has been received this season. It will be remembered that two years ago considerable trouble was experienced from this source. There are a number of species which often invade houses and are attracted to the pantry, cellar, and outhouses, where provisions are kept, especially sweet substances such as preserves, syrups, or sugar. Whenever the nests of ants can be located it is an easy matter to kill the colony by pouring a small quantity of carbon bisulphide into the exit of the nest, or, if necessary, a hole should be made with a stick, closing the hole promptly with soil after pouring in the liquid. When the nests can not be found, or when the nests are in such places that carbon bisulphide can not be used, other methods must be employed. Ants can be enticed to small sponges moistened with sweetened water, and when these sponges become covered with ants they can be dipped into boiling water, which quickly kills the pest. A solution of corrosive sublimate, applied to the shelves and runs of ants, will often drive them away, but care must be taken with this solution, as it is poison. One of the most important steps toward preventing ants from invading houses is cleanliness—keeping sweets well covered and avoiding the spilling of syrups and the like on shelves and floors.

PLATE X



Calliephialtes Messer-Grav. Parasite of Codling Moth

PLATE IX.

PARASITE OF THE CODLING-MOTH (*Caliephialtes messer*).

1. Female, showing dorsal aspect.
2. Female, showing ventral aspect.
3. Male, dorsal aspect.
4. Female insect in the act of oviposition.
5. Pupa.
6. Larva.

All greatly enlarged.

THE CODLING-MOTH PARASITE.

Caliephialtes messer Grav.

Owing to the ravages of the codling-moth in California, which have very largely reduced the profits of apple-growing, and, in some cases, made it almost impracticable, the State Horticultural Commission has endeavored to seek out and introduce some effective check upon this pest.

To this end, the *Caliephialtes messer* Grav., a member of the Ichneumonidæ, a parasitic family of the Hymenoptera, was introduced from Europe some two years since. In its native home it was found to be a very effective check upon the codling-moth, and it was hoped that by introducing and caring for it in California it would prove at least as effective as it had been in sections of Europe. Special attention has been paid to this parasite during the past two years; it has been introduced into a great many sections of the State, and gratifying reports have been received in this office regarding its work where it has been established.

We wish to guard our readers and the fruit-growers of the State generally against expecting too much from any parasite, or from any remedy that can be applied. In the first place, every one should understand fully that an injurious insect, once firmly established, can never be thoroughly eradicated. All that we can hope is to so far check its ravages as to leave a large percentage in favor of the agriculturist. It is too much the case with people that they depend upon beneficial insects to do all their work, and having once introduced them expect the pests to disappear entirely. With a thorough understanding that a parasite will simply serve as a check upon injurious insects, we may state that the *Caliephialtes messer*, the parasite introduced for the codling-moth, has been successful. We may also state that it is, so far, in its experimental stage, and that it is likely to prove of increasing value with each passing year, as its numbers increase and it becomes more widely disseminated over the State.

We have received a very extensive correspondence in this office from different sections of the State where the parasite has been established, and most of the writers speak of it in very favorable terms.

The insect is a very swift-flying one, hiding in the thick foliage of the trees, and is very difficult to find, even by experts, so that it may exist in large numbers in an orchard and yet pass unnoticed, unless one understands where to look for it and to recognize it when it is seen.

We publish herewith a colored illustration of the *Caliephialtes messer*, which, while the figures are very much enlarged, will give our readers a very excellent idea of the general appearance of the insect. The plate represents the female, showing the under and upper surfaces; also the male insect, and the female in the act of laying an egg upon the codling-moth larva. It also shows the larval or grub form of the fly, and the insect in process of transformation.

The *Caliephialtes messer* was first described by Gravenhorst in his "Ichneumonologia Europæ," from which the following description is taken:

"*General Characteristics.*—The feet are reddish yellow, the posterior tibia slightly curved; the ovipositor the length of the body.

"*Specific Description.*—Form well proportioned and having breathing pores in the segments. Length about seven lines. Head with yellow antennæ. Thorax punctate, slightly testaceous at base of wings. Wings testaceous-hyaline. Stigma and radius fulvous, base and membrane brittle. Feet rufous (reddish yellow), with posterior tarsi fuscous. Tibia arcuate, and fuscous above. Abdomen three times as long as thorax and slightly narrower, cylindrical, all tubercles on lateral prominences. Ovipositor as long as body."

An examination of the colored plate will show that the most peculiar feature of the female is the ovipositor, or egg-laying tube, which is as long as the rest of the body. This is composed of five parts, the two outer and larger of which compose the sheath, and the inner ones the ovipositor proper. Two of the inner parts are very slender and furnished at the tip with transverse ridges like the teeth of a saw, and are slightly concave on the inner side, fitting against a groove in the large piece, which is blade-like. This groove forms the oviduct, down which the egg passes into the body of the worm.

When about to lay her eggs the female walks slowly over the rough bark of the tree, carefully examining every nook and crack in which a worm may be hidden. This critical examination is made with her antennæ, which she inserts into each crevice. When a cocoon is located, a condition of excitement is evident in the rapid vibration of the wings and the swift, yet careful, movements of the antennæ, covering every part of the cocoon, evidently in search of the most vulnerable point of attack. Here the female displays a most remarkable instinct, for through her antennæ she is able to determine whether the inclosed larva has been previously parasitized. A careful examination of several hundred parasitized worms showed that in no case have two eggs or larvæ been found in a single cocoon.

When the female is satisfied that the cocoon contains a healthy worm, she elevates her abdomen until it forms almost a right angle with the rest of her body, and the entire ovipositor is then bent downward between the second and third pairs of legs and against the thorax until the tip rests on the cocoon. The sheath of the ovipositor then springs quickly upward, resting at a point that would be slightly above an imaginary line running parallel with the thorax. The next process is sawing through the tough substance of the codling-moth cocoon. The female brings into play the muscles in the tip of the abdomen, which force the ovipositor down and inward, the ovipositor resting against the abdomen, which prevents it from bending outward. At the same time she firmly grasps the bark with her feet, bracing herself for the operation. In this position, with her abdomen elevated, she uses her entire body as a derrick, and slowly, but surely, saws a hole in the cocoon. The tip of the ovipositor is slightly enlarged and, as soon as the tip is forced through the opening, she has the worm at her mercy, and after reaching the body of the imprisoned larva she gives it several sharp jabs in quick succession. Her ovipositor is then thrust in to its full extent. The insect remains perfectly quiet in this position for several minutes, seemingly oblivious to her surroundings. During this time there is a slight quivering motion of the ovipositor while the egg is being forced down. After depositing her egg, she moves in a circle with the ovipositor still thrust into the cocoon, and probably to make certain that no mistake has been made she gives the worm a couple more quick jabs, when she passes on to the next worm, where the operation is repeated.

The egg is long, narrow, almost transparent, wider at one end than the other, grayish white in color, and shiny in appearance. It is usually deposited on the outside of the worm, at or very near the wound made by the ovipositor. The egg hatches in a few hours into a minute grayish-white grub or maggot, which begins at once to devour the host worm. It grows very rapidly and, in warm weather, is full grown in about seven days. It continues to feed for about eight days more, when the food supply is generally exhausted and nothing is left of the worm but the empty skin and head. At the end of fifteen days from the time the eggs are hatched, the larva begins to spin a cocoon of its own, usually within the cocoon of the codling-moth larva. The cocoon spun by the parasite is darker in color, more parchment-like, and of stronger material than that of the codling-moth. In another seven or eight days this cocoon is finished and the larva commences to assume the pupa form; but there is no perceptible shedding of a skin, only a gradual change comes over the larva, which slowly changes to a pupa. When climatic conditions are favorable, the pupa stage has a duration of about sixteen days. The fly fully matures inside the cocoon, and in making its escape cuts a little round hole in the parchment-like cover of the cocoon, through which it works its way to freedom. The males of this species, as in others of the Ichneumonidæ, emerge first and impatiently await the coming of the females. The sexes mate soon after the females emerge, and after feeding for a day or so, the latter are ready to deposit eggs. The life of the adults is greatly governed, among the females, by the number of available worms. Where a female can readily find sufficient worms to deposit all her eggs, her life is short, but females in test cases have lived over thirty days. The males, in confinement, die in from twelve to fifteen days. However, in some cases, the life of the male is also extended. Just how many eggs the female lays has not been fully determined, but nearly two hundred adults have been reared from a single female. The life cycle thus appears to be from thirty to forty days, according to conditions of temperature.

During the past year this insect has been bred out in large numbers at the insectary; it has been distributed as widely as possible, and the experiment has been watched by this department with much anxiety. A large number of letters have been received from parties in whose orchards the parasites were planted, and these are generally of such a tone as to very greatly encourage the work, and give assurance that if an exterminating enemy for the plague has not been obtained, we shall at least have succeeded in securing one which will materially check its ravages. The following extracts are taken from letters which have been received in regard to the work of this new parasite:

"The parasite of the codling-moth I received two years ago is now spread over twenty acres of pear orchard, and this year those pears were free from codling-moth. I don't mean by this that a percentage was free, but the entire crop where the parasite was is clean and free from worms. Other orchards where the parasite has not reached are badly infested with codling-moth."—*J. R. Banks*, *Laughlin*.

"In regard to a colony of the codling-moth parasite which I received some eighteen months ago, I would say that I received the colony and put the insects in the orchard, according to directions. Since that time I have never been able to detect the insect in the orchard; but from the fact that my apples and pears this year were fairly free from worms in that orchard, I judged that the parasite is still active. I did not spray for the codling-moth at all in the orchard where I had placed the parasite, and yet the fruit was cleaner than where I had sprayed."—*Clyde M. Frisbie*, *Manager Shade Farm*, *Anderson*.

"The parasites were placed on an apple tree which the year previous showed over fifty per cent of the fruit damaged by the codling-moth. The flies were put on the trees at the close of the blossoming period.

In the subsequent crop of fruit the infection was reduced to about twenty-five per cent."—*L. R. Curtiss, Riverside.*

"The parasites were liberated in one orchard, as directed. My apples this year in this orchard were as free from worms as I could wish, only one per cent having worms. In another orchard twenty per cent were infested. Both orchards received the same spraying."—*Paul H. Cordes, Gilroy.*

"The Board received one colony, which was liberated in an orchard below Anderson, and, I understand, with good results."—*George A. Lamiman, Olinda.*

"I am picking my apples at the present time and will not have as many wormy apples this year as last, and in the orchard where I liberated them I have not two boxes to the hundred of wormy apples, while last year I had at least twenty. In my other two orchards, about 300 yards distant, the wormy apples will be about five boxes to the hundred. I think this parasite has solved the codling-moth problem in a far better way than spraying, as I spent both time and money spraying, yet the codling-moth kept right on increasing in numbers."—*C. C. Tichenor, Bellevale, San Mateo County.*

"I wish to say that I am very much interested in these parasites, having spent considerable time in an orchard in the Dry Creek Valley, where a colony was liberated two years ago, and also in an apple orchard near Geyserville. I discovered the parasite in both orchards, though they are hard to find if one does not know just where or how to look for them. They have done good work in both of these orchards, as the apples for the past two seasons have been almost entirely free from worms. The owners as well as myself feel certain that it is the parasite that has brought about these excellent results."—*G. W. Miller, Healdsburg.*

"Mr. Desnoyer, of Chino, says that he has often seen the parasites flying about in the orchards, and to verify this statement I caught some and found them to be identical with those liberated. In 1905 he lost fifty per cent of his crop, and this year his loss was reduced to twenty-five per cent."—*John Wasson, Pomona Times.*

THE GYPSY AND BROWN-TAIL MOTHS.

Considerable correspondence has been carried on between the Horticultural Commissioner of this State and prominent parties interested in checking the ravages of the gypsy and brown-tail moths in Massachusetts, and it is due to the fruit-growers of California that some information in regard to this matter should be given them.

The terrible ravages of the gypsy-moth are generally well known to our fruit-growers, and its history from its first introduction up to the present time is not unfamiliar. The outbreak of this fearful pest was due to the escape of one female moth which had been introduced into Malden, Massachusetts, by an enthusiastic but careless entomologist, who little realized the extent of the damage that could be done by one insect. Its increase was noted after several years, although little attention was paid to it until it became a really serious pest, when public attention was directed thereto and an effort made to get rid of it. Exterminative work was commenced in Massachusetts in 1890, and continued for ten years, during which period over $1,000,000 was expended in fighting this pest alone; but all that was accomplished by artificial means was to curtail the area of infestation to some extent and to prevent its spread to new sections. The continual cost of fighting this pest and the small results accomplished by the means employed led to considerable dissatisfaction among the taxpayers of Massachusetts, and, as a result, the Legislature ceased to make appropriations for the work and it was abandoned. With the abandonment of the work the moth began to increase with alarming rapidity, and the Legislature was again compelled to take the matter in hand and in 1905 made an appropriation of $300,000 for the purpose of seeking remedies or means of extermination, the work being placed under the superintendency of Mr. A. H. Kirkland.

This pest is now found throughout the whole of the eastern portion of Massachusetts, southeastern New Hampshire, and a region in and about Providence, Rhode Island. It has been reported several times from Connecticut, and is gradually spreading in all directions.

As a result of the inefficiency of artificial methods in checking the pest, interested parties in Massachusetts applied to the Commission of Horticulture of California to ascertain the possibility of securing and introducing parasites which will work upon it. This Commission has never doubted that effective parasites could be found and secured. The

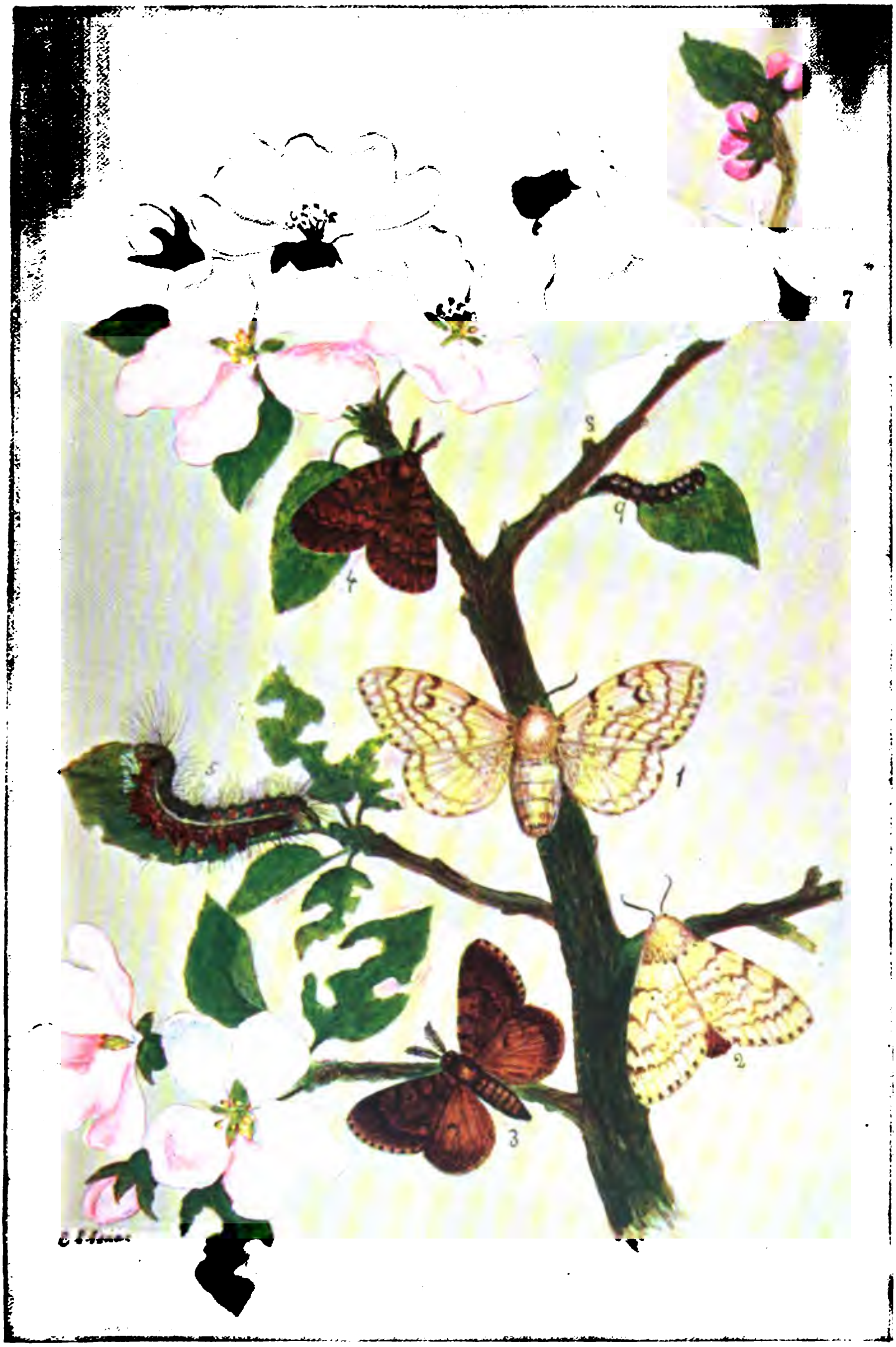
PLATE X.

GYPSY AND BROWN-TAIL MOTHS.

1. Gypsy-moth (*Porthetria dispar*), female, wings expanded.
2. Gypsy-moth (*Porthetria dispar*), female, wings folded.
3. Gypsy-moth (*Porthetria dispar*), male, wings expanded.
4. Gypsy-moth (*Porthetria dispar*), male, wings folded.
5. Gypsy-moth (*Porthetria dispar*), larva.
6. Brown-tail moth (*Euproctis chrysorrhœa*), female, wings expanded.
7. Brown-tail moth (*Euproctis chrysorrhœa*, female, wings folded.
8. Brown-tail moth (*Euproctis chrysorrhœa*), male, wings folded.
9. Brown-tail moth (*Euproctis chrysorrhœa*), young larva.

All natural size.

PLATE XI



Gypsy and Brown Tail Moths

moth has been known in Europe from time immemorial. It has been observed in England on several occasions, and while on the Continent it sometimes appears in large numbers, it as invariably disappears and can not be counted a serious pest even where it is the most prevalent. In England it has never obtained a foothold in spite of numerous introductions. The moth is also known in other parts of the world, where it has never been considered a pest and is unquestionably kept below the danger limit by some natural enemy.

A second pest, closely allied to the gypsy-moth, and commonly known as the brown-tail moth, was also introduced into Massachusetts some years ago, and while not so well known to our readers as the gypsy-moth, it has spread with greater rapidity and threatens to be an even greater pest in the sections infested by it than has been the gypsy-moth. This insect was first introduced into Somerville, Massachusetts, early in the past decade, and was supposed to be a native species, but the rapidity of its increase, and the fact that there was apparently no natural check upon it, led to an investigation and it was discovered that it is a European species probably introduced into the new world by accident. The knowledge of the devastation wrought by the gypsy-moth led to a special appropriation being made for the fighting of the brown-tail moth also, which was placed in the hands of the Gypsy-Moth Commission, which availed itself of all known artificial means—spraying, burning, fumigating, hand-picking, and every other method—to check the spread of both pests, but in neither case were they successful, and in 1900 the appropriation for fighting the brown-tail moth was discontinued with that of the gypsy-moth. Since then, this insect has spread rapidly through southeastern New Hampshire, Maine, New Brunswick, and elsewhere in the New England states, and has become even more an object of dread among the horticulturists than the gypsy-moth itself. This, as stated before, is a European species, and in Europe has been known from time immemorial, but has never been reported as a very serious plague, nor has it ever increased with the alarming rapidity, or in such vast numbers, as it has in its New England home—evidence sufficient to indicate that there is some natural check working upon it.

In the fighting of this pest, as with the gypsy-moth, the advice and assistance of the California Commission of Horticulture were sought, and a voluminous correspondence was carried on between parties in Massachusetts and this office relative thereto, until finally an offer was made to search for, secure and introduce an effective parasite for both of these pests for a specified amount, sufficient to cover the cost of the labor performed. This was done on the theory that it is far better to check a pest while it is still in a limited area and can be handled with comparative ease and effectiveness, but which is threatening to spread until it might possibly reach our own State, than to wait until it has gained a foothold here and caused a vast amount of damage.

While two such pests as those under consideration are ravaging a large area in New England, although the trouble seems to be very remote to California, there is still danger that specimens may be brought into our own State and we be called upon to fight the enemy in our own home at a vastly greater outlay of money, to say nothing of the destructive work that would be done by them if once introduced.

Recalling the experience which California has had in the introduction of parasites, and knowing the good work that is being done by them, Massachusetts in its distress naturally turned toward us. Nothing came of the proposition, however, as the entomologists of Massachusetts in conjunction with the Bureau of Entomology at Washington combined together to work along the same lines; and Dr. L. O. Howard spent a large part of the summer of 1905 in Europe and made arrangements with entomologists in different parts of that continent to send every known parasite of these pests to Massachusetts. We have learned from Dr. Howard that he succeeded in obtaining a large number of species of parasitic insects which prey upon both the gypsy and brown-tail moths. These have been secured from different parts of Europe and from different altitudes, and among them all he is in hopes that an effective check can be secured. Experiments are now being carried on with these parasites in Massachusetts, and California most sincerely hopes that an effective check may be soon obtained and the possibility of the danger from this source be removed from our State.

We present herewith a colored plate showing both the gypsy and brown-tail moths in their various forms, for the benefit of the fruit-growers of the State, and advise them to become thoroughly familiar with both pests, so that if, by any accidental means, any should be observed, they may be reported to this department at once, and never be allowed to obtain a foothold with us.

THE PEACH BLIGHT.

(Coryneum beyerinkii.)

BY CHARLES T. PAINE.

During the past three or four seasons the damage occasioned in the peach orchards throughout the State by peach blight has assumed such large proportions as to make a study of the disease imperative. The total loss of crops for several successive seasons, reported by many large growers, shows that either the ravages of the disease must be checked, or the peach industry will rapidly decline. The writer has, therefore, endeavored to gather all the information possible concerning the disease, and to present to peach-growers the methods of control which study and experimentation have proven successful in combating it.

The blight of the peach has long been known both in Europe and in this country. Few writers have treated the subject, and until this past year no one has given us a remedy for the disease which has proven successful. In Bulletin No. 20, Division of Vegetable Pathology and Physiology, U. S. Department of Agriculture, 1900, by Prof. Newton B. Pierce, the disease is aptly called "winter blight," for it is in the winter that the disease works its mischief.

Peach blight is caused by a parasitic fungus, just as are pear scab, curl leaf, and all our rots and mildews. The botanical name of the fungus is *Coryneum beyerinkii*, and it is a true parasite, living only in the tissues of the living host plant. Ondemanns first published a description of this form in "Hedwigia for 1883," page 115. The following description is taken from Saccardo's "Sylloge Fungorum":

"A very minute parasitic form growing in spots, which are black, with conidia, and having lightish-brown, cushion-like mycelium. Stipe oblong-obovate, pale olive-green, commonly triseptate, with the septate dividing it into equal parts, the ultimate segment being perhaps slightly smaller than the others. The basidia are cylindrical or perhaps slightly wider at the basal ends, hyaline, without color, and about equal in length to the conidia."

Habitat: In the trunk and branches of the peach in the Netherlands. Producing a flowing gum.

The life history of *Coryneum beyerinkii* has never been thoroughly worked out. It is in the conidial, or asexual spore-producing, stage of the fungus that the damage is done and infection takes place, and we know it best in this stage. Later appearing sexual spore forms are known by different names, but their identity with *Coryneum beyerinkii* has never, so far as the writer knows, been proven. The life cycle may then be described as follows:

The spores which have wintered over in the buds and at the bases of the twigs germinate as soon as the heavy winter rains set in. This is usually about the latter part of December or the first of January. Whether this is the regular time of germination is not yet known, but for several seasons it has been concurrent with the heavy rains and at the time named. These spores are elongate-oval in shape, and septate into 2–6 cells. Upon germination each cell sends out a tiny tube or thread between the cells of the epidermis of bud and twig down into their tissues. Only the growing parts of the twigs are attacked and penetrated by these threads or hyphæ of the fungus. These hyphæ are vegetative in character, and their aggregate is called the mycelium. They are finely microscopic in size, much branched, septate only rarely, and light brown in color. At frequent intervals on the mycelium threads, as they push their way between the cells of the plant tissue, minute lateral projections are formed that pierce the adjacent cell-walls. These projections are "suckers," and their function is to absorb the nourishing sap. These suckers are known as haustoria, and are the organs by which very many of the parasitic fungi absorb their food. They are spherical in shape and strongly contracted at their bases, where they are connected with the mycelium. The penetrated cells quickly turn brown, and finally those changes are produced which are seen as the outward manifestations of the disease.

Where each spore has developed and the mycelium ramified throughout the cambium a reddish circular or oval spot appears on the surface of the bark. When a bud, leaf, or young fruit is attacked, it turns brown and quickly dies. Within a few days after the red spots appear on the bark, short, straight tri-septate tubes or stipes are developed on the mycelium and thrust out through the epidermis. On the ends of these stipes, "mother cells," or basidia, are developed, and by the division of the basidia, "daughter cells," or conidia, are formed. These conidia are the seeds or spores. They are black at first, but soon turn brown, thus changing the color of the spots from red to black and to brown. The spores are rapidly disseminated through agencies of wind, rain, birds, and insects, and a new infection takes place to start another life cycle. The blossom and leaf buds are attacked first, and it is usually from these points that the twigs and small branches are infected.

As the growth of the fungus in the twigs and small branches progresses, they become very much spotted, gum pockets form at badly affected points, and gum exudes from them. This exudation of gum is particularly noticeable on damp days, and it may be seen hanging in drops on the under side of the branches. Often the grower's attention is first called to the disease by this very noticeable stage. When these gum pockets form, the wood itself is injured and decays to the central pith of the branch and mycelium is found ramifying throughout the brownish, jelly-like substance. Oftentimes the branches will be attacked to such a degree that they will die back several feet from their tips.

The under sides of the trees are most subject to infection by the fungus. Often the top will be left unharmed, a mere tuft, while the lower part is withered and dead. This is most unfortunate, as the lower branches are the most desirable to preserve for fruiting; but this is the case from the very nature of fungous growth. The lower part of the tree is shaded and holds the moisture, and so presents the most favorable environment for the germination of the spores and the development of the fungus. Once the mycelium has penetrated the cambium, or is within the bud, it is thoroughly protected from drought and from the sun's rays, and draws all its water and nourishment so necessary for its growth from the sap, the very life of the tree itself.

Several successive years of blight in an orchard will so injure the trees as to make them worthless for anything but the wood pile or the brush heap, and, in some cases, they have died from the severe attack. Trees affected with blight one season lose their crop not only that year, but to a large extent the following year also, for the fruit buds put forth that season are infected and injured.

When the growing months are over infection practically ceases. Green branches, with the characteristic red spots on them, last through the fall, and sections placed under the microscope show that living mycelium is present as late as October. The gum pockets are still active to a certain degree also. Thus it seems probable that the peach blight fungus goes over from one active season to another in a dormant state of the mycelium. An allied species, *Podisoma juniperi*, winters in a dormant state of the mycelium in the branches of the juniper, and many other parasitic forms do the same, so it would not be strange to find our blight doing likewise. Later examinations will prove or disprove this.

In many respects peach blight resembles the brown rot (*Monilia fructigena*) of the peach, and in some cases might be easily confused with it. The brown rot has indeed been called peach blight in a treatise by Erwin F. Smith. The wilting and killing of blossom, fruit, and twig are characteristic of both diseases, and flowing gum pockets are formed as a result of the attack of each. Brown rot does not cause spotting, however, and attacks old and mature fruit, while the blight does not.

On July 30 of this year, the State Commissioner of Horticulture sent a circular letter to each of the County Horticultural Commissioners asking for information relative to the peach blight. The main questions were, when first observed; how long prevalent; area infested; percentage of damage done, and methods of control used. Nearly all of the commissioners responded, but only the reports from counties where the disease is prevalent can be taken up in this discussion.

It was found that all the peach-producing counties of the State are affected by the blight, Tulare, Merced, Kings, Madera, Sacramento, Sonoma, Solano, Mendocino, Humboldt, and Shasta counties having received the greatest damage.

Commissioner Schell, of Fresno, reported that the blight made its first appearance in that county five years ago, but that there was no increase in its spread, nor particular damage done until two years ago. The southern part of the county was affected first, and thence it spread northward. This past season thirty per cent of the crop was lost on account of the blight.

Commissioner James A. Hill, of Kings County, reported that the blight was very prevalent there and in adjacent counties, and had been so for several years.

Commissioner J. L. McClelland, of Merced County, stated that although the blight had been noted there for the first time this year, twenty per cent of the peach crop had been lost. Dos Palos and Los Banos colonies were most seriously affected.

Commissioner George W. Harney, of Yuba City, reported that all the peach trees in the Marysville district were badly affected in twig, leaf, and newly formed fruit. Not an orchard was free from the disease.

Commissioner G. W. Whitaker, of Sonoma County, found the disease prevalent only in the eastern and northern ends of the county. Five per cent of the crop had been lost there during the past season.

Commissioner Chris. N. Tharsing, of Shasta County, reported that the blight made its appearance about Anderson in 1903 and had gradually spread since then. Commissioner Lamiman said, however, that it had not yet reached the Olinda district.

Commissioner George H. Cutter, of Sacramento County, stated that he had lost ninety per cent of his crop for the past two years. In company with him, the writer visited several orchards and found that his is only a fair example of what has taken place.

In none of the foregoing counties had an effective remedy for the blight been found and applied. Growers and horticultural commissioners of Tulare, Fresno, and Kings counties, however, had invited Prof. Newton B. Pierce, then U. S. Plant Pathologist and Director of the Government Experiment Station at Santa Ana, to visit and inspect their orchards. Professor Pierce was not unacquainted with the disease, having observed it in the Feather River bottom in 1894–95.

Solano County has suffered severely from blight. Commissioner

EXPERIENCE OF GROWERS WITH PEACH BLIGHT (*Coryneum beyerinkii*).

Name.	Address.	1905.			1906.			Varieties Affected.
		Blight.	Spray.	Date Applied.	Blight.	Spray.	Date Applied.	
C. S. Riley	Visalia	Some	L. S. S.	Late	Bad	L. S. S., Bord.	January	All varieties.
G. Geraldson	Newcastle	Some	L. S. S.	Late	Very bad	L. S. S.	Late	Crawford.
W. E. Rippey	Penryn	Some	L. S. S.	Late	Worse	L. S. S.	Late	Susquehanna, Foster, Clings.
S. C. Day	Loomis	Very little	L. S. S., Bord	Late	25 per cent	L. S. S., Bord.	Late	Crawford.
L. D. Greene	Vorden	Some	None		Worse	None		All varieties.
Isaac Phillippi	Acampo	Very little	L. S. S., Bord.	Late	Worse	L. S. S., Bord.	Late	
H. G. Boyce	Winters	Some on unsprayed trees.	L. S. S., Bord.	Early	Worse	L. S. S.	Late	St. John.
G. W. Harney	Marysville	Some	L. S. S., Bord.	Late	Bad	L. S. S., Bord.	Late	Phillips' Cling.
A. C. Sullivan	Winters	Very little	L. S. S.	Late	Some	L. S. S.	Late	Muir.
T. B. McKevitt	Vacaville	Very little	L. S. S.	Early	Very little	L. S. S.	Early	Muir, Crawford.
Wm. Brink	Winters	None	L. S. S.	Early	On unsprayed trees.	L. S. S., Bord.	Early	
F. de Gomez	Auburn	None seen	L. S. S., Bord.	Late	Bad	L. S. S.	Late	Yellow Clings.
S. M. Tool	Napa	Slight	Bord.	Late	Some	Bord.	Late	Crawford, Salway.
W. H. Barry	Courtland	Very bad	L. S. S.	Late	Very bad	L. S. S.	Late	Alexander, Hale's, Crawford.
P. D. Fowler	Tulare	Bad	L. S. S., Bord.	Late	50 per cent	L. S. S., Bord.	Late	Foster, Clings, Early Crawford.
Cutter Bros.	Sacramento	Bad	L. S. S.	Late	Very bad	L. S. S.	Late	Early varieties.
Mrs. S. Runyon	Vorden	Bad	L. S. S.	Late	Slightly less	L. S. S.	Late	All varieties.
Runyon & Dorsey	Courtland	Bad	L. S. S.	Late	Crop failure	None		
J. R. Chadbourne	Suisun	Bad	Bord.	Late	None	Bord.	Before Dec. 15	All varieties.
J. S. Brown	Suisun	Bad	Bord.	Late	None	Bord.	Before Dec. 15	All varieties.
Wm. Pierce	Suisun	Bad	Bord.	Late	None	Bord.	Before Dec. 15	All varieties.
C. N. Tharsing	Anderson	Some	L. S. S., Bord.	Late	Worse	L. S. S., Bord.	Late	Clings.
J. R. Banks	Laughlin	Bad	None		Very bad	None		All varieties.
G. N. Whitaker	Santa Rosa	Some	None		Worse	None		Muir, McClish Cling.
F. Giannini	Tulare	Bad	L. S. S., Bord.	Late	None on sprayed trees.	L. S. S., Bord.	Early	

J. R. Chadbourne first found blighted trees in his orchard in 1899, and for the past four years it has been general in distribution. In 1905 the loss was particularly great, sixty per cent being a fair average of the loss sustained. It is from experiments carried on in the Suisun Valley during the winter of 1905–06 that we gain our first positive knowledge as to how the disease can be controlled and practically stamped out. These experiments will be taken up when we come to the subject of methods of control.

The commissioners of San Diego, Orange, Los Angeles, Riverside, San Bernardino, Ventura, Santa Barbara, Alameda, El Dorado, and Lassen counties reported that the disease had not yet reached them; but in these counties peaches are not grown extensively.

In May of this year, Mr. George H. Cutter, having become alarmed at the increasing prevalence of the blight, and being able to secure but little information on the subject, addressed a letter of inquiry to his fellow commissioners throughout the State and to many growers of peaches. Questions were asked as to how prevalent the blight was, what remedies were used, and the date of application, for both the years 1905 and 1906. These replies he has kindly turned over to the writer and they are given on page 243 in tabular form. Presented in this form the eye and mind can readily take in the conclusions to be deduced from them.

Peach blight has gained a strong hold in California. Wherever blight existed in 1905 it is worse in 1906, and places which were free from it in the past experienced its inroads last season. Clings, Crawford, Muir, and early varieties of peaches seem to have suffered most severely. All varieties are affected in most cases, however, and no positive assertion as to the susceptibility of certain varieties to blight can be made at present. The most striking conclusion to be drawn is that in regard to spraying. Sprays, both with the Bordeaux mixture and with lime, sulphur, and salt, have been used by all but three growers in their efforts to control the disease. In all cases but five the spraying was done late, that is, in the latter part of January and in February. Failure was the uniform result for those who sprayed late, and success for those who applied the remedy early in the season. Recent letters from Runyon & Dorsey, and from P. J. Huth, for Mrs. S. Runyon, state that although their spraying was done late and their crops were a failure, their trees made a thrifty growth during the summer, and for that reason they assert that there was some improvement over the preceding season. At Vacaville, where the spraying is usually done early, on account of the earliness of the season, the blight has done little damage and has not increased as it has in other places.

The reason for the total failure to prevent blight by late spraying is easily seen when the nature of the fungus is considered. The fungus spores resting in the buds and crevices in the bark had germinated and entered the tissues of the tree before the spray was applied. Once beneath the epidermis of bud and twig, the mycelium is fully protected. It is a waste of good material to spray for it in this stage, for the fungus can not be destroyed without destroying its host as well. If the mycelium of the fungus remained dormant in the branches during the early part of the winter, as seems probable, it had renewed its activities and borne a new crop of spores to be disseminated through the orchard before the spray was applied, and a multitude of new infections had taken place. But where the spraying was done early, that is to say, finished by the first of January, the wintered-over spores were destroyed and any fresh lot borne by dormant mycelium were killed by contact with poisons on the surface of the branches.

In February, 1905, Prof. M. B. Waite, of the U. S. Department of Agriculture, at the request of Messrs. Chadbourne, Pierce, and Brown, visited the peach orchards in the Suisun Valley. The damage for that season had already been done, but for the following season he advised spraying with Bordeaux mixture early in December.

Accordingly Mr. Brown commenced spraying December 6, 1905. He continued spraying at intervals until February, 1906, covering different blocks of orchard at each application. Messrs. Pierce and Chadbourne followed the same plan, so that different blocks of trees, well separated from each other, and sprayed at different times, were made to act as a check one upon the other.

The results were uniform throughout. The blocks of trees sprayed before December 15 were entirely free from blight. Those sprayed from December 15 to January 1, 1906, were only slightly affected. From January 1 to 15 a certain amount of benefit resulted from the spraying, but there was still considerable blight. Trees sprayed after January 15 were blighted just as badly as those which were not sprayed at all. Several other growers made the same experiment and the result was the same in each case.

The Bordeaux mixture used in these experiments was stronger than is customary, the formula being 16 pounds of copper sulphate and 35 pounds of quicklime to 100 gallons of water. Mr. Chadbourne writes concerning it as follows: "I think after the first year this wash can be used a great deal weaker, and possibly the first year; but that is the way we used it on an orchard that had not produced a crop for the past three years, and this year three fourths of the crop was thinned off by hand, trees tied and propped, and still the trees are breaking down from the overload of fruit."

The Bordeaux mixture can undoubtedly be used in a weaker solution and still produce good results. It is the time of application rather than the proportion of ingredients that is most important. The spores of the fungus must be destroyed before they germinate, and it is useless to apply remedies after germination has taken place. Experience has shown that this must be done early in the winter and before the rains set in. Weather conditions must govern, to some degree, the spraying operations, but by starting to spray as soon as the pruning is over in the fall, or as soon as the leaves have fallen, it can all be finished by December 15. The ground to be covered will be the guide for each grower to govern his time of commencing operations.

Pruning out all dead and diseased limbs and plowing under or burning all leaves and weeds will remove great sources of infection. If the dead, gummed, or spotted branches are removed, the infection from wintered-over mycelium is certainly removed.

The lime-sulphur-salt formula has been used and found effective in destroying the spores of the peach-blight fungus. Where an insecticide as well as a fungicide is needed, the lime-sulphur-salt spray will do double duty. Bordeaux is, however, our best fungicide, and its use is recommended wherever the blight is prevalent to a high degree.

Since the peach-blight fungus (*Coryneum beyerinkii*) has been known to exist in California for at least ten years, it seems probable that the climatic conditions of the past three or four years have been the cause of its becoming a pest. The peach industry of the State was very great ten years ago, and yet the trees were not affected by blight, so that the increase in acreage and consequent opportunities for spreading the disease can not have been the cause. Fungi are, to a very high degree, dependent upon moisture. If a spore which has germinated is subjected to a dry atmosphere for a short time even, it dies. A long-continued rainy season is, then, very conducive to the rapid growth and multiplication of fungi. The comparatively heavy rainfall throughout California for the past three or four years has afforded, then, the very conditions which are most conducive to the growth of the peach-blight fungus. Instead of but one or two generations of spores, very many have been able to germinate and start new colonies of the parasite to growing throughout our peach orchards. Should dry years again prevail, the fungus might cease to be a pest; but those are conditions which few of us desire or hope for.

Remedies.—The following sprays will be found effective:

Bordeaux Mixture.

Copper Sulphate (bluestone)	15 pounds
Quicklime	25 pounds
Water	100 gallons

Dissolve the copper sulphate in a barrel or wooden vessel containing 25 gallons of cold water. Slake the lime in a small amount of water and add water to make 25 gallons. Pour the lime water slowly through a fine screen into the copper sulphate solution, stirring the while, and add 50 gallons of water. Apply the spray while fresh, using a pump that will maintain 150 pounds pressure. This will insure every part of the tree being reached, and a spray that is a mist will cover thoroughly every bud and twig. Cloudy days when there is no wind are best to work in.

The use of a larger proportion of lime than is usual in the Bordeaux mixture gives the wash greater lasting qualities, as it is not so easily washed off by rains. Where it seems best to use the lime, sulphur, and salt wash, the following formula will be found effective:

Lime, Sulphur, and Salt Wash.

Quicklime	40 pounds
Sulphur	20 pounds
Salt	15 pounds
Water	60 gallons

Make the sulphur into a thin paste with hot water; place the unslaked lime in a tight barrel, and add the sulphur paste and from 10 to 15 gallons of boiling water. Cover the barrel with sacks and a wooden cover and let it stand until the violent boiling has ceased. Then stir the mixture until the boiling ceases entirely, add the salt and enough hot water to enable the mixture to be strained into the spraying tanks, and add the required quantity of boiling water. Apply while hot.

Summary.—1. Peach blight is a disease which has but recently reached importance in California, although it has been known to exist here for more than ten years.

2. All the large growing peach sections of the State are affected by the blight, the loss varying from five to ninety-five per cent of the crop. Thirty per cent would perhaps be a fair estimate of the damage done.

3. The blight is caused by a parasitic fungus, *Coryneum beyerinkii*, and its action is to destroy the buds, twigs, and young branches during their semi-dormant condition in winter. Infection takes place by the first of January, and the damage is done before the usual time of spraying in February.

4. Late spraying has in all cases failed to check the blight, while spraying done before December 15 has proven successful in completely controlling the disease.

5. Spraying with Bordeaux mixture before the middle of December, combined with clean culture and cutting out of all dead and diseased branches, will prevent blight.

MISCELLANEOUS.

Reclamation of Alkali Land Near Fresno.

An Experiment in Silk-Raising.

RECLAMATION OF ALKALI LAND NEAR FRESNO.

BY CLARENCE W. DORSEY,
In charge of Alkali Land Reclamation, Bureau of Soils,
U. S. Department of Agriculture.

An experiment has just been completed by the U. S. Bureau of Soils which should prove of considerable interest to the fruit-growers of California. This is the successful reclamation of a 20-acre tract of alkali land south of Fresno, in Central Colony. The history of the alkali question in the Fresno district is doubtless familiar to many of the readers of this publication. All who have followed the development of this flourishing raisin and fruit center know how from a few insignificant patches alkali has greatly spread, in recent years causing in extreme cases complete abandonment of some of the choicest vineyards and orchards. This is especially the case south of Fresno, for, as is well known, little if any alkali exists in the red hardpan soils north and east of Fresno. Various remedies have been suggested from time to time, yet there is no recorded instance of a single field having been permanently reclaimed after having once been ruined by excessive quantities of black alkali. Slowly the area of alkali land has encroached upon the fertile vineyards and fields, which have rapidly depreciated in value, while the apparently helpless farmer has made little or no effort to check the damage.

With the gravity of the situation in mind, then, it is especially gratifying to report that in one of the most badly affected sections a tract of land has been so freed from alkali that the owner of the larger part of the tract is now contemplating planting again the sensitive vines. The work, moreover, is practical in application, and the cost is such as to commend it to owners of alkali land or to those seeking investment for unemployed capital.

The tract of land where the experiment was undertaken is situated 4½ miles south of Fresno, at the junction of Fig and Central avenues. The soil is a fine sandy loam, locally known as white ash land, derived largely from volcanic detritus. Throughout the Great Valley of California this class of soil frequently contains appreciable quantities of alkali. It is underlain at irregular depths by white calcareous hardpan, varying in thickness from a few inches to several feet. The land was first cultivated many years ago, at which time the ground water was quite deep. Traces of alkali were generally present, and occasional alkali patches of limited extent were frequently noticed by early settlers. Those areas, underlain at slight depths by continuous thick beds of hardpan, were of little value for fruits or farm crops, but the greater part of the tract was considered choice land. In fact, part of the tract yielded handsome crops of fruit and at one time was valued at $350 an acre.

With the continued practice of irrigation on this and adjoining lands the ground water, originally very deep, gradually rose. With this rise in ground water alkali began to make its appearance on the surface. Conditions grew worse until about 1899, when almost all of the tract was abandoned for useful crops. The alkali-resistant Bermuda-grass occupied most of the soil, yielding a slight return as pasture land. Occasional trees and vines remained that made feeble growth, but were no longer of commercial value. This brief statement of the abandonment of this tract on account of alkali is the history of many farms in the neighborhood formerly of high value.

During 1900 a systematic classification and study of the soils was made by agents of the Bureau of Soils. The alkali question received careful consideration at the time, and explicit instructions were given in regard to the treatment of the various classes of alkali soils found in the district. Suggestions were made to prevent the rise of alkali in productive soils, as well as certain rules to be followed to reclaim soils containing excessive quantities of alkali. In 1901 concerted effort on the part of Fresno merchants and farmers south of Fresno resulted in the undertaking of an experiment to free certain lands from alkali. A tract of land was chosen 4½ miles south of Fresno. The plan of the experiment was to lay tile at a depth of 9 feet for a distance of nearly one-half mile along the east side of Fig avenue. Since no gravity outlet was available, the drainage system was to discharge into a deep sump hole at the intersection of Fig and Central avenues. It was believed that lands from one eighth to one fourth of a mile on each side of the line of tile would be greatly benefited. While a considerable sum of money was subscribed, principally by the farmers in the vicinity, and the work of digging the trenches begun, unforeseen difficulties finally resulted in the abandonment of the project.

Early in 1902 the Bureau sent representatives to select a suitable site for a demonstration experiment in alkali land reclamation. Although there were many objections to the tract already selected, after due deliberation the Bureau decided to accept this as a location for such an experiment, inasmuch as a waterwheel had been installed to remove the drainage water, and several hundred dollars' worth of lumber and drain tile had been delivered. On account of the height of the ground water at this time (April, 1902), no further work was done until November of the same year. In November a drainage system was installed, consisting of drain tiles ranging in diameter from 3 to 6 inches. The system consisted of a main drain about 2,000 feet in length, with short laterals discharging into it at irregular intervals. The main drain discharged into a sump hole located at the intersection of Fig and Central avenues. The drainage water was removed by means of a Chinese pump operated by a waterwheel that had been installed when the first experiment was undertaken. The main drain was not located along Fig avenue, as originally contemplated, but some little distance east, in order that the fields heavily charged with black alkali might be more greatly benefited by the drainage. The drainage system embraced approximately 20 acres, and was installed at a depth of from 2½ to 5 feet from the surface.

Copious flooding early in 1903 greatly diminished the alkali content in the upper layers of the soil. In view of the fact, however, that the water-table still remained close to the surface, the reclamation of the upper layers of soil was not permanent, so that in certain portions of the tract a concentration of alkali again took place in the top soil. During this year, also, considerable difficulty was experienced in keeping the tiles free from silt. The fine micaceous silt entered the tiles almost as readily as water, and restricted the efficiency of the drainage system. In some few places it was even deemed advisable to relay certain portions of the system.

During 1904 flooding was again continued and the greater part of the tract freed from alkali to a depth of 2 or 3 feet. Remunerative crops of wheat and barley were grown on much of the tract that had not produced profitable crops for years. Alfalfa sown on portions of the tract in the late fall made good growth. This crop yielded several heavy cuttings during 1905, while other parts of the tract again produced good crops of barley and wheat. The returns from the crops of 1905 alone were sufficient to pay the cost of the drainage system.

While the removal of the alkali from the upper layers of soil had been satisfactory and profitable crops could be grown, the successful lowering of the water-table demanded further consideration. This was realized to be a difficult problem, since the ground water rises to within a very short distance from the surface on the tract as well as on surrounding lands. With the ground water standing at a depth of even 3 feet from the surface during at least a portion of the year, the chances are quite favorable for a second accumulation of alkali in the upper layers of soil. Considerable damage may result from a water-table that fluctuates from a depth of 8 feet in the winter months to 3 feet during the growing season of the summer. Fluctuation of the water-table, aside from its bearing on the alkali question, inflicts the maximum injury by drowning the new root growth of vines, fruit trees, and other deep-rooted crops. Any permanent lowering of the water-table, then, would appear very desirable. In any such question, however, there is the governing factor of the cost in installing drainage systems below certain depths.

Believing that much permanent benefit would result in lowering the water-table even a few feet, a new drainage system was installed in November of 1905. The system was enlarged somewhat and all drains placed from 1 to 3 feet deeper than the original system. The last few hundred feet of the main drain averaged more than 7 feet in depth, while most of the laterals were slightly more than 4 feet deep. The sump hole for receiving the drainage water was also enlarged and excavated to a depth of 10 feet. To keep the drains open and effective at all times a small galvanized wire cable was laid in all lines of tile. To this cable steel wire brushes may be attached and drawn through the tiles as often as necessary to keep them free from silt and roots. A centrifugal pump was connected with the waterwheel, to remove the drainage water from the sump hole.

With the opening of the irrigation season in January, 1906, the ground water rapidly rose from 8½ feet to the lower portions of the main drain. The centrifugal pump at once proved capable of easily removing the drainage water, together with the varying quantities of sand and silt discharged into the sump. While the removal of the alkali by flooding had proceeded satisfactorily in previous years, the results were especially gratifying after the installation of the new drainage system. The greatest change was due to the lowering of the ground water. It was soon found that the ground water was kept several feet below the surface not only on the tract, but also in lands situated some little distance away. Certain cellars fully three fourths of a mile distant were reported to be perfectly dry for the first time in years, while ponds likewise some distance from the pump stood at a much lower level than formerly. As the season advanced the area affected by the drainage system grew in extent, until perhaps two hundred acres were more or less directly benefited.

The quantity and position of the alkali in the tract were also materially affected by the new drainage system. While formerly it had been possible to leach the alkali downward some distance in the soil, the exact depth was limited by the height at which the ground water stood. With the first drainage system this was admittedly too shallow. With the water-table not more than 3 feet from the surface, conditions are very favorable for a return of the alkali to the surface, unless the utmost precautions are taken. With a deeper and more efficient drainage system, however, this danger seems to have been eliminated, and when once the alkali is leached to a depth of 4 or 5 feet there is little chance of its being returned to the surface, even by the excessive evaporation of the long, hot summer. This refers to that portion of alkali remaining in the soil and not carried away by the drains. After repeated flooding for some time, it will be found that the alkali content of the soil is so greatly reduced that the portion remaining need not be considered at all.

This, briefly, is a short description of the experiment at Fresno. To ascertain the bearing this experiment may have upon the question of horticulture and related subjects in California and adjoining states we must give some consideration to alkali and its relation to arid soils. Alkali, as is well known, is an accumulation of water-soluble mineral salts. These salts are principally the chlorids, sulphates, and carbonates of sodium, magnesium, calcium, and potassium. In countries of little rainfall all soils have an abundance of mineral salts. The rains are not sufficient to leach away all the salts set free during the formation of soils from rocks; hence, soils of arid regions contain more soluble mineral matter than the soils of regions of abundant rainfall. In moderate quantities these salts are beneficial, but when accumulated in quantity they prevent the growth of valuable crops. These salts can only move within the soil when dissolved and held in solution by water. Under natural conditions they may remain practically unchanged for years, or heavy rains or floods from the mountains may dissolve them and carry them to lower basin-like depressions. Before the advent of irrigation the soluble salt may move up and down in the upper few feet of soil, depending on the depth to which the rains penetrate the soil. The rains dissolve the salts and soak into the soil, carrying along the salts held in solution. Some of the rain water evaporates within the soil, but the greater part returns to the surface by capillary attraction—that force which causes the oil to rise in the wick of a lamp to replenish that utilized by the flame.

When canals are built in an arid district and irrigation practiced for the first time, the position of the soluble salts is no longer allowed to remain unchanged. The use of large and often excessive quantities of water dissolves the salts held in the soil, and there soon commences a definite movement of the salts from the higher lands to the lower levels. These lower areas gradually accumulate sufficient alkali to cause a material reduction in the crop yields, with the final ruin and abandonment of the land. Gradually these areas of alkali lands increase, unless prompt measures are taken at the very time irrigation is begun.

This is the history of nearly every irrigated district. There is practically not a single irrigated district in the United States that does not contain some land so strongly impregnated with alkali that useful crops can not be grown. The area of alkali land may be less than one per cent in certain districts, while in other districts it may exceed thirty per cent. Conservative estimates, based on careful surveys of many of the most important irrigated districts, show that ten per cent of all the areas examined contain too much alkali for profitable cultivation. Of this ten per cent much can be profitably reclaimed, but for some of it it is doubtful if reclamation from alkali will be profitable for many years, if at all.

While the area of ruined alkali lands is large, it is important to note that it is rapidly increasing in many sections. It should be noted that in nearly all irrigated districts there are certain soils which, on account of their naturally well-drained condition or certain other desirable characteristics, are free from alkali, and probably will always remain so. Fortunate, indeed, is the farmer who has chosen land of such a nature. Other lands, on the contrary, soon develop alkali, unless the greatest precautions are taken. Yet even in the worst alkali districts small tracts of land are frequently seen that remain productive when all around them is an alkali waste. These oases, as they may very properly be termed, usually prove that certain practices have maintained the fields in good condition, while other methods of irrigation, cultivation, and cropping have hastened the abandonment of the surrounding land. The object of the farmer situated in a district where there are already indications of alkali or where there are evidences that conditions are favorable for alkali accumulation is to handle his land in such manner that it will remain productive for an indefinite time. It is much cheaper to prevent alkali from accumulating in fertile soils than to reclaim them after they have accumulated excessive quantities of alkali.

The principal point to remember is that the salts comprising alkali only move within the soil when dissolved in the soil moisture. If water is applied to a carefully leveled field, the salts on the surface are dissolved and penetrate the soil as deep as the water. If only sufficient water is applied to soak a few inches into the soil, the salts are carried to a corresponding depth. If sufficient water is added to a porous, well-drained soil not only to saturate the soil but also to flow away into the country drainage, the soil is then freed from as much salts as the water was able to dissolve. Repeated heavy applications of water will eventually leach away practically all of the soluble salts from a well-drained soil. It has even been proved that water carrying large quantities of salts may be used without fear of injury on well-drained soils. This shows the advantage of keeping the soils in a well-drained condition. Rarely, however, except on the higher lands, are the soils maintained in such a condition after irrigation has been practiced for years. The too often excessive use of water raises the water-table, especially in the low places, and there is constant capillary connection between the surface and the saturated subsoil. Soils in such condition are constantly accumulating alkali. It may require years to accumulate an amount sufficient to cause the abandonment of the land, but it will eventually take place, the time depending on the salt content of the water evaporated at the surface. There are vineyards in the Fresno district which have not been irrigated for years and are steadily accumulating alkali, greatly to the surprise of the owners. Little do they realize that while depending upon subirrigation they are slowly ruining their vineyards. It is because there is some evaporation at the surface in spite of repeated surface cultivation, and every part of water making its way to the surface carries a certain quantity of salt. Even deep furrow irrigation, frequently the most economical manner of applying water, tends gradually to accumulate at the surface whatever alkali is contained in the soil so moistened. Often an occasional smoothing of the surface and a few heavy surface irrigations will leach the alkali accumulated at or near the surface to such depth that it may require years for it to reascend. There are few irrigation districts that do not have at least every few years an abundance of water for such flooding purposes. Even when the ground water fluctuates greatly during the year, generous floodings at the beginning of the irrigating period when the water-table is still low will be found to benefit undrained land greatly. The irrigator should prevent indefinitely, if possible, the rise of the ground water, for with the ground water permanently maintained several feet below the surface there is little chance of large accumulations of alkali taking place in the upper few inches of soil.

Cultivation in localities where there are indications of alkali should be with a view of restricting evaporation at the surface as far as possible. With surface evaporation entirely eliminated, but little if any alkali would accumulate on the surface, but it would remain more evenly distributed in the lower depth of soil. Unfortunately, we can not entirely eliminate surface evaporation, though by frequent cultivation we can greatly restrict it, even where crops are grown that leave much of the soil unoccupied. As a matter of fact, crops that entirely cover the soil with a dense shade are undoubtedly to be recommended for soils containing appreciable quantities of alkali. The dense shade checks evaporation quite effectively, while much of the soil moisture is thrown off by the growing plant. By maintaining a well-drained condition of the soil to a depth of several feet, by occasional smoothing and surface irrigation, and by growing crops that shade the surface, or by frequent cultivation, the farmer may keep his farm in a high state of cultivation in the midst of lands being ruined by alkali.

Since it is possible to protect fertile lands from alkali, what can be said about reclaiming them after once they can no longer be profitably cultivated? We have already described the successful experiment south of Fresno. It is possible to reclaim the greater part of the alkali lands in California and other arid states, but the question of cost must alone decide as to whether the farmer desires to undertake such work or not. First, he must determine their value in their present condition, their value when reclaimed, and the cost necessary to reclaim them. There are lands in the Fresno district which at one time earned handsome returns on a valuation of $250 an acre. Those same lands now sell for $30 and less an acre as Bermuda-grass pastures. By a reasonable expenditure of time and money these lands can again be made to return handsome profits. The first essential step is thorough drainage, in case the ground water is within a few feet of the surface. With the ground water several feet deep artificial drainage may not be necessary, but it will greatly hasten the final reclamation of the land. The depth necessary to drain, the distance apart for the drains, as well as the kind of drainage, whether open or closed drains are needed, all depend on several factors which must be carefully considered before a decision is reached. Porous, sandy soils require fewer drains than tenacious clay soils, while a few deep drains may be far more effective and more economical than many shallow ones. No drainage system should be installed without the advice of a thoroughly competent authority on the subject. Such advice frequently is the means of saving considerable sums of money, as well as vexatious delays in the final outcome of the work. The cost of drainage will vary according to local prices for the necessary labor, for ditching, for drain tile or lumber, in case closed drains are needed, as well as with the presence or absence of hardpan, the depth of quicksand, if such exists, and finally with the texture of the soil. The cost may be as low as $10 an acre, and should rarely if ever exceed $50 an acre. A conservative price in California would be from $15 to $25 an acre, not including the cost of pumping plant, in case no gravity outlet is available.

In passing, it may be well to emphasize that well-drained soils are warmer and earlier in the spring, require less water to make them productive, and conserve their moisture supply longer. From this statement of the advantages to be gained by drainage it must appear that it is well worth the expense to drain even alkali-free soils, since it is in the nature of a permanent improvement and an insurance against alkali, the cost of which will soon be returned in the increased yields from the more highly improved soil. After having supplied an efficient drainage system, the leaching away of the alkali depends upon the rapidity with which water moves through the soil and upon the character of the alkali. White alkali is more readily leached from soils than black alkali. The greater part of the black alkali is leached readily enough from the soil, but small quantities frequently remain in the soil in spite of repeated leaching. Layers of hardpan necessarily retard the reclamation of alkali soils, and in case there are continuous beds of hardpan of considerable thickness lying a short distance below the surface, it is to be doubted if reclamation will prove a paying investment. Soils underlain by such formidable beds of hardpan have not a high value even when free from alkali, so their reclamation is not to be advised as long as more easily reclaimed lands are to be had at low prices. The experience of the Bureau of Soils has been that with a deep efficient drainage system, basin irrigation will leach away large quantities of alkali in a few months. With the water-table 4 or 5 feet below the surface there is but little chance of a further accumulation. Even if a second accumulation should take place after several years, it is an easy matter to practice surface flooding for a short time and again leach away the slight accumulation. It is true that repeated flooding may have a somewhat bad effect on certain soils, especially those heavy in character, and yet there is no way to remove large quantities of alkali from soils except by supplying sufficient water to dissolve and leach away the noxious salts. Deep cultivation will aid in destroying the bad physical effect caused by flooding and at the same time will render subsequent flooding more effective by allowing the water more readily to penetrate the soil. In some few cases it may even be advisable to plow-under liberal applications of well-rotted manure on soils easily damaged by flooding.

As soon as circumstances will permit it will be found an excellent plan to plant some shallow-rooted crops before occupying the soil with alfalfa or permanent fruit crops. Such crops serve as a practical test as to the progress of the reclamation. When once the land is reclaimed to such an extent that sensitive crops can be grown, no fears need be entertained that alkali will again destroy the crops, provided the drainage system be kept in working order. When the drainage system, through neglect, no longer is able to keep the ground water at a safe level, a second accumulation of alkali will undoubtedly take place. None but the most careless farmer, deserving of no sympathy whatever, will allow his land to become ruined a second time after having once gone to the trouble of reclaiming it.

With the rapid development and extension of irrigation there is a widespread demand for more lands than can be brought under cultivation. In their haste individuals and companies have frequently gone far from railroad and market centers and have expended great sums of money to reclaim small tracts of barren desert. Oftentimes the same expenditure of time and money would restore to their former productiveness abandoned alkali lands situated in well-established communities, with ready markets near at hand for all classes of farm produce. Quite frequently these alkali lands have at one time had considerable sums of money spent upon them to put them in perfect condition for irrigation. The necessary ditches were all built long ago and the fields carefully leveled. Such improvements, frequently costing many dollars an acre, should not be overlooked by the prospective settler or capitalist seeking to derive the largest returns from irrigated lands with the least expenditure of money.

Alkali should no longer be allowed to ruin fields worth upwards of $200 an acre, when an outlay of rarely more than $30 an acre will prevent it. The expenditure of this relatively small sum will in many cases actually increase the former productiveness of many farms. The time will come when every flourishing irrigated center will, as a matter of pride, see that not even small tracts of alkali land are allowed to lie waste.

Alkali has long been considered one of the serious drawbacks to irrigation, justly so perhaps, but it should be considered so no longer. Alkali lands can be reclaimed too cheaply to allow even a small percentage of a highly developed irrigation district to cast doubt upon the future outcome of the entire district. The problem can be definitely solved, and for all time, but persistent, concerted effort on the part of all those interested in the question will be necessary to accomplish this.

AN EXPERIMENT IN SILK-RAISING.

Numerous attempts have been made to raise silk in California, and very much interest has been evinced in this industry at different times, but, so far, it has not assumed commercial importance. There is, however, no question but that California has all the requirements, in climatic and other conditions, to make this industry a success. Silk-raising in the countries where it is carried on is largely a domestic industry; one in which the different members of a family engage, and which is carried on at home, the cocoons, when gathered, being sold to a central filiature. Californians have not yet learned the art of rearing silkworms, nor is there as yet any sale for cocoons, if they were grown; so that, aside from gratifying a laudable curiosity, there is as yet no incentive to this industry. Yet there is no question that it might become a very important one with us if once established and properly managed. The United States imports annually, in raw and manufactured silk, from $50,000,000 to $60,000,000, a great part of which could be produced in California. With the interest being taken in this industry, and the experiments being carried on, there is no doubt that some day it will be taken hold of here, and the production of silk cocoons will give many of our people a means of earning a considerable addition to their income, and employ their leisure time with pleasure and profit.

During the past season we have watched with a great deal of interest the work of a Japanese resident of Sacramento, who, knowing something of this work, carried on experiments in silk-growing. At our request he kept a record of his labors, and the results have been tabulated by him and a report made, which is reproduced here for the benefit of those of our people who are interested in this industry. The observations have been accurately recorded, and we leave the experimenter, Mr. Kurosawa, to give the history of his experiments in his own language.

REPORT ON AN EXPERIMENT IN REARING SILKWORMS.

BY KIGORAW KUROSAWA.

A few years ago I thought of making a trial of rearing silkworms in California. In October, 1905, I came to Sacramento and chanced to see a number of cocoons in a spinning-brush displayed in a show window on Fourth street. This was a good stimulus for me, and I managed last spring to make this experiment, but with many difficulties.

Although I was born in a part of Japan where the principal industry of the inhabitants is rearing silkworms, and had gained some knowledge of this industry, I was never fortunate enough to study it scientifically. In Japan they are at present making wonderful progress in this industry, and are applying scientific knowledge to improve it.

I am thinking of going back to Japan in the near future in order that I may get the practical as well as the scientific knowledge of the industry, and after having thus equipped myself, of coming back here and starting the industry on a larger scale; for I have full confidence in being successful in carrying on this industry in this country.

I am far from being satisfied with the cocoons which the worms I rear spin; but they are, though small in size, far better in quality than those yellow cocoons which I saw last year in a show window in this city. Thus I see what the quality of the cocoons depend on—the way of rearing the worms—and at the same time I see that the general climate of California will suit the silkworms.

As I got some profit out of the cocoons which I considered poor, I believe that the industry is very hopeful in this State and worthy of serious consideration of the people.

The tables following show how I handled the worms in all ages.

JOURNAL OF THE REARING OF SILKWORMS.

One foot square is taken as the unit of the space given to the silkworms. The temperature is taken three times a day, *i. e.* at 6 A. M., at 2 P. M., and at 10 P. M. The number of silkworms was about 5,000 at first when they were laid down on the bed.

FIRST AGE.

Ordinal Day.	Date.	Weather.	Temperature.		How often food was given.	Quantity of leaves a day.	Quantity fed each time.	Nursing.	Space, Feet.
			Inside.	Outside.					
1st…	Mar. 6	Morning..Fair Noon .....Fair Night.....Fair	64° 70 50	42° 67 50	3	5¼ drs.	1¾ drs.	At 5 P. M. worms laid down on the bed.	1/5
2d …	Mar. 7	Morning..Fair Noon .....Fair Night.....Fair	63 72 72	43 68 52	6	15 drs.	2½ drs.	At 8 A. M. bed changed, space enlarged.	2/5
3d …	Mar. 8	Morning..Fair Noon .....Fair Night.....Fair	64 70 67	44 69 52	7	1 oz. 7½ drs.	3½ drs.	At 9 A. M. bed changed, space enlarged.	3/5
4th ..	Mar. 9	Morning..Fair Noon .....Fair Night ....Fair	67 73 73	48 74 64	7	1 oz. 15½ drs.	4½ drs.	At 10 A. M. bed changed, space enlarged.	4/5
5th ..	Mar. 10	Morning..Fair Noon .... Cloudy Night.....Cloudy	59 66 71	48 64 59	6	1 oz. 14 drs.	5 drs.	At 9 A. M. blue-grass seed sprinkled.	4/5
6th ..	Mar. 11	Morning..Cloudy Noon ....Rain Night.....Rain	62 69 70	52 60 54	7	3 ozs. 1 dr.	7 drs.	At 11 A. M. bed changed, space enlarged. At 10 P. M. molt began, bed changed.	1
7th ..	Mar 12	Morning..Rain Noon .....Cloudy Night.....Fair	64 70 71	52 59 45	1	6 drs.	6 drs.	At 6 A. M. feeding stopped.	1

Total.

Temperature.		Average of the Temperature.		Feeding Hours.	Molting Hours.	Times food given.	Weight of the leaves given.	Weight of a hundred molting worms.
Inside.	Outside.	Inside.	Outside.					
Morning..443° Noon .....490 Night.....499	329° 466 371	Morning.63°.3 Noon ....70 .0 Night....71 .3	49°.0 66 .5 53 .0	133 (5 days and 13 hours.)	33¼ (1 day, 9 hours, and 15 minutes.)	37	10 ounces ½ dram	¼ dram

SECOND AGE.

Ordinal Day.	Date.	Weather.	Temperature.		How often food was given.	Quantity of leaves a day.	Quantity fed each time.	Nursing.	Space, Feet.
			Inside.	Outside.					
8th	Mar. 13	Morning..Rain Noon ......Rain Night......Cloudy	60° 72 75	43° 50 50	3	1 oz. 15½ drs.	10½ drs.	At 3:15 P. M. began to feed.	1
9th	Mar. 14	Morning..Rain Noon .... Rain Night......Rain	64 72 73	41 52 50	5	2 ozs. 15½ drs.	9½ drs.	At 6 P. M. bed changed, space enlarged.	1¼
10th	Mar. 15	Morning..Cloudy Noon ...... Fair Night......Fair	59 68 69	40 50 44	6	4 ozs. 12½ drs.	12¾ drs.	At 10 A. M. bed changed, space enlarged.	1½
11th	Mar. 16	Morning..Fair Noon ......Fair Night......Cloudy	69 70 67	36 60 49	6	1 oz. 14 drs.	5 drs.	At 6:30 A. M. put 1,000 worms aside and burned all the rest.	1
12th	Mar. 17	Morning..Cloudy Noon ......Fair Night......Fair	65 70 64	44 57 42	6	2 oz. ½ dr.	5½ drs.	At 2 P. M. molt began, bed changed. At 10 P. M. feeding stopped.	1
13th	Mar. 18	Morning..Fair Noon ......Fair Night......Fair	60 72 72	39 62 48	0	------------------------	------------	Molting.	1

Total.

Temperature.		Average of the Temperature.		Feeding Hours.	Molting Hours.	Times food given.	Weight of the leaves given.	Weight of a hundred molting worms.
Inside.	Outside.	Inside.	Outside.					
Morning..377° Noon ......424 Night......420	243° 331 278	Morning..62°.8 Noon ......70 .7 Night......70 .0	40°.5 55 .2 46 .3	102¾ (4 days, 6 hours, and 45 minutes.)	36 (1½ days.)	26	13 ounces, 10 drams	2 drams

THIRD AGE.

Ordinal Day.	Date.	Weather.	Temperature.		How often food was given.	Quantity of leaves a day.	Quantity fed each time.	Nursing.	Space Feet.
			Inside.	Outside.					
14th	Mar. 19	Morning..Fair Noon .... Fair Night......Cloudy	57° 74 70	36° 65 52	4	1 oz. 12 drs.	7 drs.	At 10 A. M. began to feed.	1
15th	Mar. 20	Morning..Rain Noon ......Rain Night......Rain	62 71 70	50 50 56	5	5 ozs.	8 drs.	At 7 A. M. bed changed, space enlarged.	2
16th	Mar. 21	Morning..Cloudy Noon ......Cloudy Night......Cloudy	66 72 67	53 62 56	5	5 ozs. 10 drs.	9 drs.	At 9 A. M. bed changed.	2
17th	Mar. 22	Morning..Cloudy Noon ......Cloudy Night......Fair	64 70 70	58 72 53	5	9 ozs. 6 drs.	7½ drs.	At 8 A. M. bed changed, space enlarged.	4
18th	Mar. 23	Morning..Cloudy Noon ......Rain Night......Cloudy	60 71 68	52 59 54	6	14 ozs. 8 drs.	9½ drs.	At 8 A. M. bed changed.	4
19th	Mar. 24	Morning..Fair Noon ......Cloudy Night......Cloudy	62 72 70	49 70 59	3	6 ozs. 8 drs.	9½ drs.	At 2 P. M. molt began, bed changed. At 7 P. M. feeding stopped.	4
20th	Mar. 25	Morning..Fair Noon ......Cloudy Night......Rain	60 71 70	53 72 58	0	----------------------	------------	Molting.	4

Total.

Temperature.		Average of the Temperature.		Feeding Hours.	Molting Hours.	Times food given.	Weight of the leaves given.	Weight of a hundred molting worms.
Inside.	Outside.	Inside.	Outside.					
Morning..431° Noon......507 Night......485	345° 450 388	Morning 61°.5 Noon ....71 .5 Night....69 .3	49°.3 64 .3 55 .4	125 (5 days and 5 hours.).	46 (1 day and 22 hours.)	28	2 lbs. 10 ozs. 12 drs.	10½ drams

FOURTH AGE.

Ordinal Day.	Date.	Weather.	Temperature.		How often food was given.	Quantity of leaves a day.	Quantity of leaves at a time on one space.	Nursing.	Space, Feet.
			Inside.	Outside.					
21st..	Mar. 26	Morning..Cloudy Noon ......Fair Night......Fair	60° 70 69	52° 65 50	2	6 ozs.	12 drs.	At 5 P. M. began to feed.	4
22d ..	Mar. 27	Morning..Fair Noon ......Fair Night......Fair	62 72 64	44 68 49	5	1 lb. 2 ozs. 12 drs.	10 drs.	At 3 P. M. bed changed, space enlarged.	6
23d ..	Mar. 28	Morning..Fair Noon ......Fair Night......Cloudy	65 67 70	47 72 59	5	1 lb. 6 ozs. ½ dr.	11⅔ drs.	At 9 A. M. bed changed.	6
24th .	Mar. 29	Morning..Cloudy Noon ......Cloudy Night......Cloudy	64 70 69	56 70 58	6	1 lb. 14 ozs. 6 drs.	13⅓ drs.	At 8 A. M. bed changed.	6
25th .	Mar. 30	Morning..Rain Noon ......Cloudy Night......Rain	63 70 68	58 62 57	5	2 lbs. 8 drs.	12⅓ drs.	At 10 A. M. bed changed, space enlarged.	8
26th .	Mar. 31	Morning..Cloudy Noon ......Cloudy Night......Fair	58 64 69	53 64 46	5	2 lbs. 2 ozs. 6 drs.	13¼ drs.	At 9 A. M. bed changed.	8
27th .	April 1	Morning..Fair Noon ......Fair Night......Fair	55 68 70	45 56 52	5	2 lbs. 2 ozs. 6 drs.	13¼ drs.	At 9 A. M. bed changed. At 10 P. M. molt began; bed changed.	8
28th .	April 2	Morning..Fair Noon ......Fair Night......Fair	63 70 72	46 56 52	3	7 lbs. 1 oz. 4 drs.	11⅓ drs.	At 11 A. M. feeding stopped.	8
29th .	April 3	Morning..Fair Noon ......Fair Night......Fair	70 71 72	47 57 52	0	....	--------	Molting.	8

FOURTH AGE—Continued.

Total.

Temperature.		Average of the Temperature.		Feeding Hours.	Molting Hours.	Times food given.	Weight of the leaves given.	Weight of a hundred molting worms.
Inside.	Outside.	Inside.	Outside.					
Morning..560° Noon......622 Night......623	448° 570 475	Morning.62°.2 Noon.....69 .1 Night.....69 .2	49°.8 63 .3 52 .8	162 (6 days and 18 hours.)	54 (2 days and 6 hours.)	36	11 lbs. 3 ozs. 12½ drs.	3 ozs. 3¼ drs.

FIFTH AGE.

Ordinal Day.	Date.	Weather.	Temperature.		How often food was given.	Quantity of leaves a day.	Quantity of leaves at a time on one space.	Nursing.	Space, Feet.
			Inside.	Outside.					
30th ..	April 4	Morning..Fair Noon .....Fair Night......Fair	70° 72 70	47° 72 58	2	¾ lb.	¾ oz.	At 5 P. M. began to feed.	8
31st..	April 5	Morning..Fair Noon......Fair Night. ....Fair	68 71 70	52 78 58	5	3 lbs. 2 ozs.	1 oz.	At 8 P. M. bed changed, space enlarged.	10
32d ..	April 6	Morning..Fair Noon......Fair Night......Fair	65 71 71	50 78 56	4	5¼ lbs.	1¾ ozs.	At 2 P. M. counted the worms, 1080. Space enlarged. Spread 90 worms in each space.	12
33d ..	April 7	Morning..Fair Noon. ....Fair Night......Fair	67 70 69	50 76 55	4	6 lbs. 2 ozs.	2¼ ozs.	Bed twice changed—in the morning and afternoon.	12
34th ..	April 8	Morning..Fair Noon......Fair Night......Fair	67 72 68	48 75 57	4	7½ lbs.	2½ ozs.	Bed changed twice—morning and afternoon.	12
35th ..	April 9	Morning..Rain Noon......Cloudy Night......Cloudy	68 71 71	55 75 64	4	7½ lbs.	2½ ozs.	Bed changed twice—morning and afternoon.	12

FIFTH AGE—Continued.

Ordinal Day.	Date.	Weather.	Temperature.		How often food was given.	Quantity of leaves a day.	Quantity of leaves at a time on one space.	Nursing.	Space, Feet.
			Inside.	Outside.					
36th	April 10	Morning..Rain Noon......Cloudy Night.....Cloudy	71 72 69	57 71 51	4	7 lbs. 13¾ ozs.	2¾ ozs.	Bed changed twice—morning and afternoon.	12
37th	April 11	Morning..Fair Noon......Fair Night......Fair	65 74 72	46 74 53	4	7½ lbs.	2½ ozs.	Bed changed twice—morning and afternoon.	12
38th	April 12	Morning..Fair Noon......Fair Night.....Fair	66 73 71	46 74 59	5	7½ lbs.	2 ozs.	Bed changed twice—morning and afternoon.	12
39th	April 13	Morning..Fair Noon......Fair Night......Fair	68 72 68	48 78 58	5	6¼ lbs.	2 ozs.	From early in the morning some mature worms found. At 1 P. M. space decreased.	10
40th	April 14	Morning..Fair Noon.....Fair Night......Fair	64 75 68	50 80 65	5	4⅓ lbs.	2 ozs.	At 10 A. M. space decreased. At 6 P. M. all worms went to their cocooning.	7

Total.

Temperature.		Average of the Temperature.		Feeding Hours.	Molting Hours.	Times food given.	Weight of the leaves given.	Weight of a hundred mature worms
Inside.	Outside.	Inside.	Outside.					
Morning..739° Noon......793 Night......767	549° 831 643	Morning.67°.2 Noon.....72 .1 Night.....69 .3	49°.9 75 .5 57 .9	241 (10 days and one hour.)	0	46	63 lbs. 15¾ ozs.	11 ozs. 5 drs.

First Age.—During this period I had three troubles with the worms: the first one was about the hatching, the second was about the rearing room, and the third was about the substances to be used in making beds for the worms.

1. On the evening of March 5, 1906, I brought the eggs of the silkworms from San Francisco, and opened the package. The color of the eggs showed the near approach of the hatching. I found that twenty per cent of the eggs had already hatched. I brushed away these that were already hatched, and placed the rest in an incubator. On the next morning I took the eggs out and again brushed away those that were hatched. I kept the worms that were hatched after these two brushings and reared them, for I considered them to be healthy worms.

2. The room which I used for the silkworms was the first floor of a two-story house. The ceiling was low and the air damp, and there was no heating apparatus. I had to use an iron stove to heat the room; consequently the temperature could not be even in all parts of the room. Thus it was very ill suited for the rearing of silkworms; but afterwards I got an idea of using electric lamps for heating purposes, and hung them under the shelves. This device enabled me to regulate the temperature.

3. In Japan millet-husks are used to prepare beds for the worms of the first age, but as millet-husks were not obtainable in Sacramento, I experimented to find the best substitute for millet-husks. I toasted cornmeal and tried it, but found it was very injurious to the worms, for almost half of them died within a short period. Then I tried graham flour, but this did not seem to be a good substitute. One evening after these experiments, I was walking on K street and chanced to see some bluegrass seed displayed in a show window. I thought this must be a good substance for the silkworms, and tried it. It was good for the worms, indeed. After I began to use the bluegrass seed I did not find any dead worms in the trays. They were sound and healthy, and without any further trouble they went into their first molt or sleep.

Second Age.—All the worms came out of their molt almost at once; and they were healthy and active almost beyond my expectations. I thought that if they grew up in this manner, in their fourth age I should not be able to get sufficient food for them, and that without any help I could not take sufficient care of them; therefore, after keeping them for two days and sixteen hours after they began to feed on leaves, I put about a thousand worms aside and destroyed all the rest. During this period the weather was changeable; but the worms were very healthy, and without any trouble went into their second molt.

Third Age.—During this period the weather was very changeable. There were not many sunshiny days; almost every day it was rainy or windy or cloudy. I experienced much trouble in gathering mulberry leaves; but as I took special care to keep the leaves in the proper condition, the worms were not affected by the weather at all. They were all sound and healthy, and went into their third molt in very good condition.

Fourth Age.—In Japan rice husks are used to make beds for the worms in this period; but as the bluegrass seed was too expensive, and as I did not know what was a good substitute for rice husks, I simply sprinkled mulberry leaves over the worms, and as soon as the worms got on the leaves I carried them with the leaves into new trays, and if the worms were still sticking to the old leaves, I took them off with my fingers, though I was afraid that this might hurt the worms; but it afterwards appeared to me that this process did not hurt them at all, for all the worms were sound and healthy.

Fifth Age.—I counted all the worms on the second day after all of them came out of their sleep. There were a thousand and eighty worms. I gave every ninety worms a square foot of space. They were active and healthy, and I thought if they should continue to grow in this manner every hundred of them would weigh about a pound and three ounces at the time when they were ready to spin; but they did not get along as well as I expected. As I was not ready with the net to make the beds for the worms, I was compelled to handle them with my fingers, and there was no doubt that I hurt the worms a little, and also the beds were not kept quite clean and dry, for I was kept busy in gathering leaves and had no one to help me. Thus they became less healthy than they used to be. Their appetite was much poorer than I expected. They could not consume all the leaves, though I fed them only four times a day. When they were ready to spin, every hundred worms weighed only 11 ounces and 5 drams.

Thus ended my experiment in rearing silkworms. This must be considered a failure. But this failure evidently came from the lack of care and the incompleteness of the apparatus. If I could take care of them to my satisfaction and had the proper apparatus, I have no doubt the experiment would have shown far better results. Though the experiment ended in a failure, still it did not leave me without any profit. The profit that I got off the cocoons was enough to pay me for my trouble. In considering all matters, I can draw the conclusion that the rearing of silkworms is a hopeful and profitable industry in California.

Throughout all ages I used a low temperature, for I had no help and was afraid that I could not attend to them quite well. If I had kept up a temperature of 72° F. throughout, the worms would have spun within thirty days.

REPORTS

OF THE

COUNTY BOARDS OF HORTICULTURE.

REPORTS OF THE COUNTY BOARDS OF HORTICULTURAL COMMISSIONERS, FOR THE YEAR 1906.

ALAMEDA COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: I herewith respectfully submit my annual report for the year ending October 1, 1906.

The condition of fruits in this district has, as usual, been clean and free from smut. *Rhizobius ventralis* are yet to be found in some localities in sufficient numbers to collect for distribution, yet I find enough of them in all orange and olive orchards to keep the trees in a clean condition and the oranges free from smut. During the past two months I distributed about 8,000 among the apricot orchards wherever they were needed.

The prune orchards are almost free from the brown apricot scale (*Lecanium armeniacum*), which is kept in control by *Comys fusca*, whose good work on the apricot scale can be seen plainly at any time of the year.

I found four or five isolated orange and lemon trees infested with cottony-cushion scale and fortunately discovered a sufficient supply of *Vedalia cardinalis* to enable me to place a couple of colonies on each tree.

The *Scutellista cyanea* have increased beyond my expectations, and I have collected hundreds and distributed them in many orchards. I have found their larvæ in the black scale in the apricot orchards, showing that they are gradually spreading throughout the district.

These are all the insect pests we have to contend with, and hope that in the future, as in the past, we will be able to keep them in control with their natural enemies.

Apricots, prunes, cherries, pears, and peaches (very few peaches) are the leading fruits raised in this county. Oranges and lemons do well also, but are not raised in commercial quantities, as the other fruits are found to be more profitable.

The only spraying done in this district is for the ever-present codling-moth, but fortunately the pest was very scarce this year.

A new industry has been started this year in this county by a canning company, which has purchased about one hundred tons of French prunes for canning purposes. In assorting them they select the firm fruit for canning and dry all that are too ripe. This year for the first time we cooked them for our own table (firm, fresh prunes), and I have no hesitancy in pronouncing them the most delicious fruit I have ever eaten. I presume they are just as desirable when put up by the canners, if proper care is taken in the process.

The importation of trees and plants into this district has been as follows: From France and Iowa, 160,000 seedlings, consisting of Mazzard, pear and apple, and 264 plants from Australia. Of young trees, there have been only 550 pear and peach trees imported from Utah.

Respectfully submitted.

WM. BARRY, Commissioner.

To the Honorable State Commission of Horticulture.

SIR: The yield of fruit has been extremely light in this section this year. Apricots, cherries, and almonds were nearly a failure, while pears yielded about half a crop.

Very little stock has been received from other countries, our home nurseries supplying the demand. The exception was one consignment of seedlings from France, consisting of 5,000 apples, 5,000 pears, and 10,000 cherries.

The trees are exceptionally free from scale insects, but apple trees are badly infested with codling-moth. The parasite *Caliephialtes messer*, placed in pear trees, seem to have done their work.

The pear blight has not yet made its appearance in this section.

The fungous diseases—brown rot on the stone fruits, and pear scab—have been very bad this season. Spraying did not seem to check them.

Many of the orchardists are digging up their trees and preparing their land for rhubarb, tomatoes, and cucumbers. The area in tomatoes this year amounts to about 1,300 acres, yielding nearly 14,000 tons, or over a quarter of a million cases of canned goods.

Of dried fruit, we have produced about 270 tons of prunes and 200 tons of pears. At the cannery 100,000 cases of assorted fruits were packed.

The nurseries supplying cut flowers for the market are increasing in number. At present there are over one hundred hothouses, covering over seven acres of ground.

Respectfully submitted.

EDW. O. WEBB, Commissioner.

BUTTE COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: We beg to submit the annual report of the Butte County Horticultural Commissioners.

The principal commercial fruits raised in this county are prunes, peaches, almonds, pears, and oranges. For oranges we have one of the earliest sections in the State, the first oranges for shipment East having been picked on November 7. We will have an average crop of oranges this season, and the quality will be the best in the history of Butte County. We have had one of the heaviest crops of prunes in the history of the county, but the peach and almond crops were very short, owing to the cold and late rains, which caused more or less peach blight.

During the past few years there have been heavy plantings of almond and peach trees, and in the southern part of the county a large number of grapevines have been set out. In the past, grapes were not raised here very extensively, but a few good bearing vineyards have convinced the people that grapes can be raised in Butte County, and as a consequence many vineyards have been planted. So far as we can ascertain, this county is apparently free from grape diseases.

Our orchards here are practically free from San José scale and fungous diseases. We find that we can avoid peach blight, to a great extent, by spraying our peach trees with Bordeaux mixture early in December. We used an orchard for a test, and laid it off in blocks. In December this orchard was sprayed as follows: Block No. 1 was sprayed with Bordeaux mixture; Block No. 2 was left unsprayed; Block No. 3 was sprayed with lime, sulphur, and salt, and so on throughout the entire orchard. In February all blocks that were left unsprayed in December were sprayed with Bordeaux mixture and lime, sulphur, and salt, each spray being used in separate blocks, as follows: The blocks left unsprayed in December next to the ones sprayed with Bordeaux mixture at that time were sprayed with Bordeaux mixture, and the ones left unsprayed next to the ones sprayed with lime, sulphur, and salt were sprayed with the lime, sulphur, and salt solution in February. The blocks sprayed in December with Bordeaux mixture were entirely free from blight and bore a heavy crop, while the ones sprayed with lime, sulphur, and salt in December were about fifty per cent as good, and the blocks sprayed in February showed considerable blight and had hardly any fruit at all.

In pear blight we have done considerable experimental work under the instruction of Government experts from Washington, but the results have not been satisfactory, except in cases where the work was done thoroughly and under our personal supervision. The pear blight does not seem to be nearly as bad this season as it was last.

There have been quite a number of trees imported into this county from various sections of the United States and from foreign countries. We have been very careful in examining all trees coming from other counties in this State and from sections outside the State. All trees coming from outside of this State are thoroughly fumigated, as also are all trees going out of this county.

During the past year there were imported into this county about 200,000 trees, shrubs, vines, and plants, from the following sections: New Mexico, China, France, Japan, New York, Alabama, Oregon, Ohio, Washington, Missouri, Pennsylvania, Washington (D. C.), Nebraska, Texas, Mississippi, and Korea, and different sections of California. A great many of these trees which were shipped into the county have been used for experimental purposes.

During the past year there have been shipped out of this county about 2,500,000 trees, shrubs, vines, and plants, to the following sections: New Mexico, British Columbia, Canada, Washington, Idaho, Montana, Nevada, Oregon, and various points in California. All trees shipped have been thoroughly examined and fumigated before leaving the county.

In the vicinity of Chico during the past season there have been green and dried fruits produced as follows:

	Green.	*Dried.*
Almonds	------	62,125 lbs.
Apples	898,100 lbs.	------
Pears	428,100 lbs.	47,600 lbs.
Peaches	1,498,900 lbs.	663,685 lbs.
Prunes	8,472,900 lbs.	2,824,300 lbs.

The next season there will be a great many young orchards coming into bearing, and if given proper care and attention, in accordance with our instructions regarding spraying, there should be one of the largest crops of fruit ever raised in the history of Butte County.

Respectfully submitted.

T. F. STILE, Secretary.

CONTRA COSTA COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: I herewith hand you the report of the Horticultural Commissioners of Contra Costa County for the year ending October 1, 1906. As our county has fortunately escaped the most troublesome diseases affecting other horticultural districts, the most important work of our Board has been in inspecting orchards and advising fruit-growers in a general way.

In District No. 1 there are two nurseries—the only ones in the county. These grow and also import trees from various parts of the State, which they sell throughout the county. Besides these, very few plants are handled by private parties, excepting grapevines, which are grown and sold by Messrs. John Swett & Son of Martinez.

Though many scale insects are to be found on various kinds of trees, no damage has ever resulted, as these can be held in check at a small expense. Several kinds of aphids appear during the spring, but these seem to have always been kept under control by their natural parasites and climatic conditions. One of the most valuable of these parasites is our California red ladybird, which is found in large quantities all over the orchards.

Owing to the late spring rains and warm fogs, fungous diseases affected to some degree almost every variety of plants. However, no great damage resulted from these, except from the mildew in the lowland vineyards. The late rains also injured fruit-blossoms, so that in many places the crop was far below the average. This is especially true of cherries and apricots.

About two years ago pear blight was first discovered in this county near Martinez. Immediate steps were taken to inspect the county and it was found to exist in several districts, especially in the Ygnacio Valley, where the largest pear orchards are located. No time or pains were spared by our Board in inspecting the orchards and instructing the growers in the method of eradicating this dangerous disease. I have personally inspected the orchards in my district, and always attended to the cutting. Last year blight was cut out in seven orchards; this year I found only three affected trees in one orchard. People in my district are very jubilant over this success, and are planting pear orchards without fear.

In District No. 2 blight had taken a stronger hold, and though several orchards have been successfully cleaned, blight is still present in a few scattered places. This winter, however, I intend assisting the Commissioner of District No. 2 in getting rid of all blight found in this county.

Of all difficult problems encountered by our fruit-growers, phylloxera, the grapevine louse, is the hardest to solve. Grape-growing in our county was one of the most profitable industries of the agriculturist for several years, and, as a result, large areas have been planted to vineyards of wine and table grapes. For the last eight years phylloxera has been steadily spreading, until now it is found in every vineyard in the county. Probably over half the vineyards are already destroyed and the rest are dying very rapidly. Several varieties of resistant vines have been tried in replanting the vineyards, but so far most attempts have been only partially successful. Owing to our long dry summers no resistant vine has yet been found that will grow table grapes and live over a period of five to eight years. This is very disastrous to our locality, as our soils, climate, and commercial facilities were all very favorable to the table-grape industry. This viticultural problem is at present very vital to most parts of California, and in behalf of the grape-growers I would recommend that much attention be given to this matter.

Respectfully submitted.

A. JOSEPH TAVAN, Secretary.

EL DORADO COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: I have the honor to forward this the report of the Horticultural Commissioners of El Dorado County for the year 1906.

It being late in the season when we were appointed as a Horticultural Board to look after the interests of the people engaged in horticultural pursuits, it at once became apparent that we could, for this year, it being our first experience, only work to a disadvantage and be of little benefit to the people. However, with difficulty we succeeded in engaging an inspector for the county, and he entered upon the work of inspection for one month at $2.50 per day, but he could not be induced to continue in the work at that salary. In order to secure the services of competent men, we think the wages should be at least $3 per day.

Our inspector found the greater part of the people ready to welcome him to their orchards, yet there were others who refused to allow him to make an inspection of their trees. The Board, considering the late date at which it had come into the field, considered it wise to enter into no litigation for this season, hoping the people would become reconciled and fall into line next season, when the Board expects to prosecute, with a more determined hand, the work of protecting those who strive to protect themselves.

In regard to pear blight, we can simply say that we have it in its worst form, and so far we find it a difficult matter to check its spread. In the past season, it has appeared in orchards farther up in the foothills than ever before, and in such cases it is found to be more destructive than lower down in the county.

Our worst insect pest is the codling-moth, which, so far, is champion, in defiance of all sprays and appliances. Climatic changes seemingly do more to hold it in check than artificial means.

So far we have found no blight in the peach trees. The little San José scale we have is easily controlled by the lime, sulphur, and salt solution.

The fruit crop for this season has been light, but, owing to the scarcity, prices ruled high, and people who had fruit to sell have done very well.

In the lower parts of the county the pear and apple crops were almost rendered worthless on account of scab.

The amount of dried fruit this season is nominal.

The setting out of young trees seems to be almost at a standstill; in fact, a great many growers are inclined to neglect their orchards altogether.

Respectfully submitted.

J. G. IRVING, Secretary.

FRESNO COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: The Board of Horticultural Commissioners of Fresno County beg leave to submit the following report for the year 1906.

The horticultural interests of this county for the past year have experienced a boom which our production of nursery stock has been unable to keep up with, causing a large importation of trees, mostly peach, from various Eastern points. We have compelled this stock to undergo a rigid inspection, and whenever found lacking have destroyed it. We advise our growers, where possible, to procure their stock for planting from reliable dealers at home, which insures them trees true to name and thoroughly acclimated.

Our peach orchards have suffered some from the so-called winter peach blight, a trouble caused by a fungus which we can now control by a liberal spraying of bluestone and lime in the proportions of 10 pounds of bluestone, 12 pounds of lime, and 50 gallons of water, put upon the affected trees before the first of December. A general campaign of spraying will be carried on, from which we expect a complete eradication of this trouble.

Our scale pests are few, and we have been able to control them with parasites.

Pear culture in this county has become a thing of the past, owing to the ravages of the pear blight, and we advocate the destruction of every blighted or liable to be blighted tree, and a stoppage of planting for two years, when we feel confident Fresno County can begin a new and successful industry in pear-growing.

Our greatest trouble or pest is the vine-hopper, for which we are trying to import a parasite from the south of France—a yellow-banded hornet called the "Sphinx," which in its home causes a large reduction in the damage due to the hopper. So far we have been unsuccessful, but hope for results in the future.

Our peach and raisin crops show a shortage this year, but with the advanced prices our horticultural interests are in a flourishing condition, with a bright prospect for the future.

Respectfully submitted.

F. C. SCHELL, Secretary.

HUMBOLDT COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: I beg to hand you herewith the annual report of this Board.

The apple constitutes the only fruit raised in commercial quantity in this county. Both soil and climate are well adapted to the culture of this fruit throughout the agricultural area, except that portion which lies directly exposed to the summer north winds. In such sections artificial windbreaks become a necessity. The mountain sections are sparsely settled, but here and there orchards planted many years ago are found to be in very thrifty condition. There has been a moderate increase in new settings and the total yield is gradually creeping up. Total shipments for the season ending October 31, 1906, amounted to 120,000 boxes.

The general quality of Humboldt apples is above the average, especially for those varieties adapted to this section. There is no cannery in this section and very little fruit is dried.

San José scale is the only pest doing any serious damage, and while the worst cases in the more remote sections have been eliminated, there appears of late a tendency to work back toward the valley section. Spraying with distillate has been recommended in most cases, and where properly applied has shown good results. But owing to the comparatively small size of most orchards, few of the growers have supplied themselves with proper spraying outfits.

Some evidence of codling-moth has been found in the remoter sections toward the north and also in the southeastern section, and great precautions have been taken to prevent its spread. One colony of the moth parasite was liberated in the Willow Creek section, and is reported to have thrived. But the orchards there are scattered and hardly any of the fruit finds its way to market.

Apple scab makes its regular appearance each season, more or less, according to the extent that weather conditions have favored its growth. Among the more progressive fruit-growers spraying with Bordeaux mixture is now being practiced as a remedy, with good results.

Pears and peaches constitute an insignificant item of our fruit yield, although very fine pears are grown in the warmer belt. Peaches suffer more or less from late frosts, and curl leaf is not infrequent.

On the whole, it may be said that the progress being made is satisfactory, and were the separate interests larger, thereby insuring proportionately greater activity, we would be able to show exemplary conditions in the way of maintaining clean and healthy orchards.

The Board has refrained heretofore from adopting arbitrary measures, but the time is approaching when this will become the rule.

The fruit this season is hardly equal in quality to that of last year, scab being more noticeable; but, nevertheless, the average quality ranks high, and wherever known has the preference in the markets, especially by reason of its comparative freedom from insect blemishes.

Respectfully submitted.

J. E. JANSSEN, Secretary.

LASSEN COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: A very close inspection has been kept on the different pests, with the result of nearly exterminating some of them.

Pear blight has been the hardest to overcome, the trees having been cut back until, in many instances, they resemble only stems without limbs. Other trees have been cut out entirely and burned, and still there is pear blight.

The apple worm from the codling-moth does not seem to be bad this year, owing, perhaps, in some instances, to the very short crop last year, while others think that keeping hogs in the orchard keeps the worms down.

Trees as a rule have made good growth this season, and seem to be in a healthy condition.

Scale of any kind is very rarely met with in the county.

The apple crop, while not heavy, is of very fine quality, the fruit being both large and highly colored.

Peaches were very superior this year, and met a ready market at home.

Mr. I. N. Jones, President of the Board, and who lives in Susanville, reports the fruit trees in his section as being in good condition. He says the birds almost took the entire berry crop.

The apple crop from this county will find a market at Reno, Nevada, this year, the Nevada crop having been killed by frost last spring. The Nevada mines afford a good market for fruit from many sections of California.

The importation of nursery stock from outside has been small this year. One Oregon firm sold some which was free from any pests known to the inspectors here.

What this section most needs is a visit from some thorough man, one who knows all kinds of pests, so that a tour of inspection could be made of the entire valley.

Peach, plum, prune, cherry, and apricot trees are very free from insects of any kind.

Respectfully submitted.

J. B. CHRISTIE, Secretary.

LOS ANGELES COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: The Board of Horticultural Commissioners of Los Angeles County has the honor herewith to submit its annual report for the year 1906.

CROP CONDITIONS.

The climatic conditions of the last year have been very favorable, producing, with improved orchard practice, the finest and best-keeping quality of citrus fruits the growers of the county have ever put out. Prices for oranges have reached the highest and most uniform rate ever received. The business has been brought to a much more satisfactory basis through a study of citrus fruit transportation by G. Harold Powell, of Washington, D. C., which has been conducted for two years. It has been of great benefit to growers in solving shipping problems, and of assistance to the Commissioners of the south in the control of insect pests, in showing that a high percentage of fruit decay in transit is caused by smutting and the resultant washing required to cleanse the fruit.

Apples have done fairly well, and many new orchards are being established in certain sections of the county. A bumper peach crop in the territory yet devoted to this fruit is reported, bringing excellent prices and restoring the peach to favor and extension. A very light crop of apricots and some of the other deciduous fruits resulted from unfavorable winter conditions and the age of the remaining orchards. In small fruits the yield has been abundant, demand and prices good, and increased plantings of strawberries, blackberries, and dewberries have followed. The yield of grapes was fair and profitable. A large crop of walnuts of fair grade has been harvested, with an immense extension of the industry in the way of new groves, one planting alone amounting to 1,000 acres. Olives bore heavily last year, one factory turning out 60,000 gallons of oil from its own orchards. This season the crop will be very light in many groves.

Taken altogether, the fruit and vegetable industries of Los Angeles County have had a most profitable year, perhaps the most profitable the farmers have ever enjoyed.

HARMFUL INSECTS.

With the exception of two incursions of the purple scale into territories heretofore exempt, and an increase of the red scale in a few localities, there has been no outbreak of scale insect pests other than the usual invasions to which Southern California has been so long subject. The destructive plant parasites of the county, from climatic causes, from the environment of so many cities and small towns, and from the neglect of suburban orchards arising through their subdivision into residential properties, seem to present difficulties of control not experienced in localities more completely given to commercial fruit-growing. However, the horticultural centers of the county, always in advance in the suppression of harmful insects, have been given a new impetus in this line by the perfection of methods of insect control, the improvement in the use of cyanide being especially marked. These, with the more intelligent reliance upon beneficial insects and the clearer view of the relation between the artificial and the natural forces that may be used toward insect repression, have placed the disinfection of orchard trees upon a most satisfactory basis, even to a degree of confidence that our most destructive kinds need never be allowed a foothold in places where they do not now abound.

Black Scale.—No incubus has ever borne with more destructive force upon the fruit business of the State than has this common scale pest, nor has any other been the cause of more research and experimentation in seeking means of control. The reports of two years ago gave assurance that an effective parasite had at last been secured for this scale in the *Scutellista cyanea*, yet we see a continuation of spraying and fumigating for this pest apparently larger every season. This course has not been necessary because of the increase of this scale, for it is a fact that the *Scutellista* has destroyed it immeasurably upon the citrus groves; it has also confined the broods of the scale to lesser seasonal bounds and made possible more effective fumigation, and it has depleted the scale to such an extent that the health of the trees is perhaps assured without the use of artificial remedies. But the *Scutellista* leaves alive sufficient scale under all circumstances to smut the fruit, perhaps lessening the frequency of fumigation, yet never controlling the pest to the point of immunity from the application of remedies. With a large number of plant species the black scale seems to have done; with all but the citrus family, where black smut is the apprehension, this scale has met an adversary that bids fair for final control.

Purple Scale.—The progress of the purple scale has been slow but resolute in two sections of the county since its introduction from Florida fifteen years ago. It has now received a check through the use of better methods of fumigation that has insured its confinement to its present bounds and its final extinction. Two new centers of infestation have been discovered within the last year and the scale wiped out of existence with the improved methods of using cyanide. The purple scale is known as the most difficult to kill of all the scales, and this extermination is the greatest achievement of insect remedies in this county. Much progress has been made in the control of this pest in the few remaining seedling groves of the infested districts by the cutting back of the trees and budding over to other varieties—a convenience in disinfection and a profit to the orchardists. In the only badly infested locality a majority of the trees have been fumigated twice this season, and the outlook is good for the extermination of the purple scale.

Red Scale.—Owing to the use of distillate spray in attempting to destroy this insect, a few of the small citrus sections have been marked by a steady increase of this scale. It is almost unknown, however, in the commercial orchards where approved remedies have been applied, and it is not greatly feared in any locality where fumigation is practiced. There are sections containing hundreds of thousands of trees where this pest has been prevented from getting even a start. As with the black scale, it finds its most extensive lodgment in the orchards of non-residents and in groves of subdivisions for residential improvements. In all territories subject to red scale, where methods of control approved by the Commission have been adopted, this insect is causing little alarm.

Other Scales.—The deciduous orchards in one or two localities have experienced a visitation of *Pulvinaria innumerabilis*, which was attacked so thoroughly by hymenopterous parasites that artificial means have not been necessary for the control of this heretofore rare scale, only in one case requiring the application of sprays. The work of the *Rhizobius* upon this scale, reported two years ago as the most remarkable event of the season, has entirely ceased, to be taken up by the scale's more natural enemy of the Chalcid order.

Little is heard of the San José scale in the county. The infestations are chiefly confined to young orchards, as the natural enemies of this pest have become so effective upon the older orchards that there now seems no danger of the return of the San José scale to the list of dangerous insect pests. The Board has treated this insect most successfully the past season with a wash of six per cent of caustic potash.

A very troublesome occurrence of the *Araucaria* scale has been noticed upon some of the splendid *excelsa* pines about the city, bidding fair to destroy many of the largest trees, on account of the difficulty of applying remedies.

Another virulent scale, *Aspidiotus rossi*, has become a persistent enemy of some of our great *Araucaria bidwillii*, causing the lower limbs of the trees to die, to the injury of the health and beauty of the trees. If some means of checking these scales is not discovered soon, two of our most beautiful ornamentals will cease to be planted.

Minor Visitants.—Orchard invasions of the mealy-bug, although confined to less than a dozen citrus groves, are serious enough to justify warning. In most cases they have come from a local nursery or greenhouse, spreading, in one case, over nearly a hundred trees. While not a very destructive pest, this insect is exceedingly difficult to handle. It produces smut and filth that in some instances require the quarantining of the fruit, and in one case the establishment of a separate packing-house for the infested groves. As yet, no effective method of combating this insect has been discovered. It is encouraging, however, that perhaps the most extensive and overwhelming colony of the mealy-bug ever discovered has been absolutely extirpated by a *Hemerobius* species, the "brown lace-wing fly," described twenty-five years ago by Mr. Craw as an effective parasite of this pest in the orchards about the city of Los Angeles.

It has been claimed by a nurseryman of an adjoining county who is notorious for shipping unclean stock, that ninety per cent of the apple trees of this county are infested with the woolly-aphis. He made this plea in resisting the quarantine regulations of your Commissioners. The Board discredited this statement last summer in the individual examination of 30,000 apple trees in the Cudahy orchard adjoining the city. Of this number but one tree had even a trace of the aphis. No more convincing fact can be set forth in proof of the value of rigid inspection by the Horticultural Commissioners of the State than this. The peach-twig borer is prevalent, causing great damage to the fruit over an area of 2,000 acres in one locality. The Commission has been actively engaged in its suppression for two years.

By calling together the growers of the district, after several meetings enough interest was developed to carry forward an extensive experiment in the control of the peach-worm. The lime-sulphur remedy was used exclusively and to such effect that several hundred acres of peach trees were sprayed there last spring. In orchards treated both in 1905 and 1906 the percentage of wormy peaches was below recognition, and thus the remedy for the peach-worm has become thoroughly established in the county.

The red spider has done very little damage generally this year, yet small areas have suffered the usual losses from this source. The dry sulphur treatment always proved good wherever properly applied.

Damage to the apple crop by the codling-moth was as bad as possible where no remedies had been used. One orchard of 25,000 trees was sprayed with "Disparene" without in any degree injuring the foliage, though near the coast. The arsenates have entirely displaced paris green.

Vegetables and small fruits have been unusually exempt from insect and fungoid attacks.

FUNGOUS DISEASES.

In some portions of the county the vineyards have suffered more than usually from the attacks of mildew. The common remedies have been advised, and in some sections both sulphur and copperas have been used with good effect. While there has been nothing alarming about this visitation, it is a fact that considerable damage has been done to the late grape crop. Perhaps the most disconcerting bacterial trouble that has to be met in our citrus orchards is gummosis. It may prove in the future to be the most destructive agency of this class. Gum disease is receiving attention at the new pathological station at Whittier, where the walnut blight is also being investigated, in both cases with no material progress. These maladies have, so far, baffled all students of plant diseases.

The walnut blight has again been prevalent in nearly every district in the county, damaging the crop as materially as it has in any previous year. Growers are anxiously awaiting the discovery of a resistant stock, or for the discovery of some cultural or remedial agency for the control of this great malady.

Two years ago the lemon crop suffered from the attack of a brown-rot, which we are informed results from the presence of a new fungus that has made its advent into the lemon groves. Much progress has been made in the study of this disease at the pathological laboratory. After repeated experiments, a solution of permanganate of potassium has been found the most potent disinfectant, and several lemon houses are now using the solution at the rate of one pound of permanganate in enough water to wash 1,000 field boxes of fruit.

No pear blight has been reported upon the young orchards. But few old trees remain in the county surviving previous attacks of this and other destructive agents upon the pear.

The peach blight has not made its appearance in the county, so far as reports and observations show.

With the exception of the leaf-spot fungus upon dewberries and strawberries, no new fungoid troubles have been encountered.

INSECT REMEDIES.

The application of remedies has reached immense proportions in Los Angeles County. Complete returns from ten districts, namely, Azusa, Glendora, Covina, Pomona, North Pomona, San Dimas, Duarte, Monrovia, Pasadena, and Whittier, show the treatment by fumigation of 587,520 bearing citrus trees, and by spraying, of 240,320 trees for the year ending October 1, 1906. The effect of this general treatment insures the finest quality of oranges and lemons for the coming crop.

Fumigation.—Never in the history of the citrus fruit business has so great advancement been made in the efficacy of cyanide in the disinfection of trees as that of the past season. For two years your Board has been experimenting with heavy dosage as the best and cheapest means of scale control. Driven to the use of greater quantities of cyanide in our efforts to stamp out the more resistant purple and red scales, the discovery has been made that the failures of fumigation in the past years have been almost altogether due to scant dosage. Carelessness of application and improper proportioning of materials used in the production of hydrocyanic acid gas have had something to do with failures also. So efficient have been the results of this increase of dosage and the change of water proportions that we have experienced an almost universal return to fumigation this fall. The statistics given above were made largely from the returns of October and November, 1905, and do not in any measure represent the ratio of fumigated to sprayed trees of the present season's work. There are now thirty-five well-equipped fumigation outfits in the field in this county, and others would have been installed but for the difficulty of securing competent fumigators. The Board has had under constant consideration the improvement of detail, the securing of uniform material, and the training of men to do more effective work in this line. Last winter a meeting of the materialmen, contracting fumigators, and inspectors was held in our office for the consideration of all matters relating to this work, resulting in a better understanding of the requirements of efficient service throughout the county. The Board has arranged with the Bureau of Entomology at Washington to conduct a scientific investigation of the use of cyanide next season, in which examination will be employed an expert entomologist, a capable chemist, and a plant physiologist to determine many points in the use of cyanide not now clearly understood by even our most advanced fumigators. This investigation has been needed for many years, and the Board is pleased to have secured it at the expense of the General Government in funds sufficient to make it thorough. The Board has done a great deal of work in breaking in new fumigators, impressing them with the necessity of care in the detail and with the practice of using heavier dosage of cyanide. Altogether the business of fumigation is now in a higher state of efficiency, which, with the cutting off of stray generations of scale by the *Scutellista cyanea*, has made the outlook for clean fruit very bright.

Spraying.—This means of scale treatment has a few advocates among our most capable orchardists, but the use of spraying compounds in the citrus groves has nearly ceased in all the citrus fruit centers. We note a great increase in the use of sprays for codling-moth, for the peach-worm, and for fungoid diseases in deciduous orchards and vineyards. Many of the old, discarded spraying outfits used two years ago in the citrus orchards are now employed in season with this kind of service.

QUARANTINE.

Your Commission reports the more than usual activity in quarantine regulations during the year. Scores of carloads of pineapples from Honolulu have been fumigated for the mealy-bug before releasing to the local markets. The Commission has enforced to the letter the quarantine placed against the introduction of Florida trees and plants by the State Commissioner. Many plants have been burned by agreement with the consignee or sent back to the consignor. This work also involved extensive correspondence with the postoffice authorities at Washington, in which there is affirmed inability under the law to assist in locating plants sent by mail from the quarantined districts and their detention when found. Arrangements have been made with the local postoffices to notify the Commission of the arrival of questionable packages and permitting their interception at the time of delivery. In several cases, plants subject to this quarantine have been taken up after planting and delivered to the Commissioners and destroyed. The apparent lack of authority upon the part of the postoffice officials and other weaknesses of our quarantine regulations suggest the necessity of more comprehensive quarantine laws.

Provision has been made with the news agencies to exclude the sale of Mexican oranges and other fruit upon the railroad trains coming into Southern California from the southwest, in which a general order has been issued to the train boys preventing their purchase of Mexican fruits for sale on the road.

The Board has destroyed several hundred boxes of oranges found upon the local markets infested with purple scale. No legal difficulties have been encountered in the enforcement of this drastic method.

Some idea of the success of the rigid inspection of both incoming and outgoing trees and plants may be had from the report of the Inspector of Los Angeles city. During the year ending October 1, 1906, he handled 525,490 trees and plants outgoing from the city yards, and 309,151 coming into the city from outside points. Of these, 3,124 were found infested with insect pests and diseases in the outgoing plants, and 1,294 incoming plants were detained for like causes. This shows 839,059 plants handled by the freight and express offices of the city, with only 4,418 infested with pests or diseases. The advantage of this systematic inspection throughout the county is incalculable, resulting not only in the betterment of the nursery and greenhouse conditions in the county, but also in the receiving of clean plants from distant points. With the maintenance of these reasonable quarantine and inspection regulations no new insect pest has been introduced into the county during the year.

Respectfully submitted.

J. W. JEFFREY, Secretary.

MADERA COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: As required under the law, I beg to submit the following report of work in Madera County during the year 1906.

During the past winter and spring I have sprayed 10,700 fruit trees with lime, sulphur and salt, for San José scale and shothole fungus. Where pests were under strong headway a second spraying was necessary, but in most cases the second spraying was unnecessary. This should be, and has been, followed with Bordeaux mixture during the month of April, which will thoroughly eradicate the pest for the season. The shothole fungus seems to be the most persistent pest we have to contend with. However, it is well under control.

Our county is now clean of San José scale and brown apricot scale.

Several carloads of trees have been imported into the county from Fresno County and one carload from Chico nurseries.

The pear blight has killed, or nearly so, all the pear trees in our county.

The peach blight has done much damage, but has been successfully checked by spraying with Bordeaux mixture; yet it leaves the trees with all lower fruit spurs and limbs dead. The lime, sulphur, and salt solution as a winter spray, with Bordeaux mixture applied in spring, will eradicate this pest.

Following are the fruit shipments for 1906: Raisins, 1,300 tons; peaches, dried, 400 tons; prunes, dried, 600 tons; figs, dried, 210 tons; apricots, dried, 150 tons; shipping grapes, 250 tons.

Respectfully submitted.

W. M. HUGHES, Commissioner.

MENDOCINO COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: I herewith submit my report. The fruit industry of my county is not as I would like to see it. Since I resigned as County Horticultural Commissioner, there has been no one appointed to fill the vacancy, but I have assisted the growers of pears wherever I could. Right now, myself and some of the other pear-growers have entered into a campaign against the pear blight, and I think we will be able to stamp out what we have. The peach-growers are also on a campaign against peach blight. The pear and apple men are preparing a campaign to stamp out the scab.

I have gone into the grape business, and I am encouraging the grape industry of the county because we have here perfect climatic and soil conditions for the growing of wine grapes, and because I can combat the diseases of grapes easier than I can those of other fruits.

Respectfully submitted.

J. R. BANKS,
Horticultural Commissioner.

The Mendocino County Board of Horticulture was discontinued for some time, and Mr. Banks's report was made for the period he was engaged. Since it was written, a new Board, composed of L. W. Babcock, J. Hamilton Smith, and F. W. Wilcox, has been organized. J. R. Banks has been appointed inspector.

MERCED COUNTY.

To the Honorable State Commissioner of Horticulture.

Sir: The general condition of the county has been very satisfactory, so far as the work of the Horticultural Commission is concerned.

Trees throughout the county have made a fine growth this year, which is accounted for by the fact that the fruit-grower has begun to realize that he can not expect a crop unless he gives his trees proper care and cultivation.

A considerable amount of nursery stock was imported from Missouri into this district the past season, enough from stocks alone to plant 1,000 acres of peaches, the principal fruit grown in this county, closely followed by apples, prunes, grapes, etc.

The orange and lemon crops promise to be of extra quality, but less in quantity this season.

In regard to diseases, we have examined every shipment of trees and vines that has come into our county, and have found them to be in fine condition.

We have succeeded in getting more orchardists to spray each year, and the people are beginning to realize and appreciate the benefits arising from the work of the County Board of Horticultural Commissioners.

Among our grapevines there is no disease that we can discover, although we have given all our vineyards a thorough examination, and all indications of disease have been thoroughly investigated.

Our peach crop for the past year was short, on account of the peach blight. We are advising fall spraying as a preventive and as a cure.

We marketed in this county about 250 tons of dried peaches. The canneries took the bulk of the peach crop. Although we are not a prune county we marketed about 200 tons or more.

The coming season will see a larger acreage of peaches planted than ever before, as the people are enthused over the high prices.

Respectfully submitted.

N. H. WILSON, Secretary.

MONTEREY COUNTY.

To the Honorable State Commissioner of Horticulture.

Sir: The past season has not been as prosperous for the orchardists of this section as in former years. The fruit of this section is mostly apples, and among the disappointments were the shortage of cars during the packing season and the presence of the apple scab. The scab appeared late, and many of the orchards that were neglected and not sprayed during the winter with the Bordeaux mixture were badly affected, and the majority of the fruit in such orchards was fit only for the drier. Last year we had little of the scab, yet sufficient to warn the fruitmen of the necessity of spraying. While the lesson has been a costly one, the orchardists are preparing to do thorough work the coming season. The bluestone and lime spray, where used early, has proved effective, and very little scab is to be found where trees were treated with the mixture.

The apples have dropped early, for reasons which are hard to determine. The world's crop of apples appears to be large and the prices for such fruit have not been as high as in past seasons. So far shipments this season, as compared with the last at this date, are about four hundred carloads less.

The apricot crop was a short one, but the high prices prevailing at the time of drying the fruit made up for the short yield.

The peach and pear blights have not made their appearance here yet. A careful watch is being kept, and should they appear the best known methods will be employed to eradicate them.

Most of the land that can be used profitably for fruit has been planted, and hence but few trees have been set out the past season, and about all of them came from local nurseries.

Young fruit trees have made a fine growth the past season.

Respectfully submitted.

D. W. ROHRBACK, Secretary.

ORANGE COUNTY.

To the Honorable State Commissioner of Horticulture.

Sir: There is comparatively little to report of the past year's work of the Horticultural Commission in Orange County.

We are seriously troubled with only one insect pest and more or less with two others. Purple scale has become scattered over a large territory and, but for thorough fumigating, would have been a serious menace to future citrus crops. Red scale and black scale are present in small quantities, but have been easily held in subjection. Few apples and pears are grown, so the codling-moth is not the subject of much attention. No blight has been noticed on pears or loquats.

Spraying for various pests is being more and more discontinued, because of poor results and damage to trees. The county now owns a good outfit of fumigating tents, and several private outfits are in use. Those of the county are rented to the growers at a fixed price for each tree fumigated. Excellent work by fumigating has been done, and the question of keeping down scale insects seems to be one of attention and expense.

Parasites for scale are present in more or less quantity, and in the case of *Scutellista cyanea* much success is apparent, but the black scale is by no means eradicated. The chalcid fly is destroying many of the red scale, but not enough to hold it in check.

Many trees and plants are handled in the county, but no great number are shipped in or out. Several carloads of palms and ornamental plants and a little nursery stock of various kinds have been sent to neighboring counties, but no record has been kept.

The question of destroying obnoxious weeds has been the subject of much discussion by the Commissioners, although little active work has yet been done. But it is the plan to begin such work in earnest this next season, for it is the belief of the Board that such weeds are likely to prove more expensive to farmers and fruit-growers than insect pests, if something is not done soon to check their spread.

Respectfully submitted.

FRED RAFFERTY, Secretary.

PLACER COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: In accordance with the provisions of Section 4 of the Act relating to County Boards of Horticulture, I have the honor to submit this, the annual report of the Board of Horticultural Commissioners of Placer County.

The past fruit season in this county has, on the whole, been a fairly profitable one. The season opened with good prices for all kinds of fruit, but nearing the end of the season prices dropped. Plums were an average crop, but peaches and pears were below the average, and not more than two thirds of the pears were marketable. This falling off was entirely due to the pear scab.

I regret to have to report that the so-called pear blight and pear scab are doing considerable damage, notwithstanding the vigilance of the Commissioners, as well as of the orchardists. At this time (the end of October) many of the growers are busy spraying their trees with the Bordeaux mixture, using double the quantity of bluestone. These same growers contemplate spraying again in January with a similar solution, and again when the fruit begins to form, but the solution to be of reduced strength. Reports have been received that in cases where this method of spraying had been carefully performed in 1905-06 results were highly satisfactory.

Another pest that is causing considerable trouble in this county is Johnson-grass. This grass was sown some years ago under the belief that it would make good forage. Now it has spread to such an extent as to threaten the destruction of many orchards, and the difficulty of its eradication is increased by the fact that its seed is easily carried about.

Trees have been imported into this county during the year from the following points: Oroville, Fancher Creek, Niles, and Salt Lake, and were found satisfactory, with the exception of one shipment from Salt Lake, which was condemned and destroyed.

Shipments of fruit from this county during the past season were as follows: Green fruits, 1,296 carloads; canned fruits, 15,700 cases; and about 40 tons of dried fruits.

The olive crop will be nearly up to the average. Many of the growers have sold their crops on the trees to Los Angeles firms, and received good prices.

Respectfully submitted.

W. J. McCANN, Chairman.

RIVERSIDE COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: As Secretary of the Board of Horticultural Commissioners of Riverside County I respectfully submit the following report of the work and expenses of the Commission in combating insect pests and diseases and destroying weed pests, as prescribed by law, for the year ending September 30, 1906.

The Horticultural Commissioners worked 703½ days, superintending the work of the inspectors, keeping a record of their work, also looking after the work of the fumigators and spraying machines. Fourteen inspectors worked 2,575¾ days, reporting the inspection of 8,512 acres of orchards (mostly citrus) and platting the location of 25,756 trees infested with insect pests. About one eighth of the inspectors' time was used in doing quarantine work, examining trees and plants coming into the county, and nursery stock going out.

The total expense of the work of the Commission for the year ending September 30 was $10,523.10. Of this amount, $468 was paid for office work and supplies, railroad fare, and livery bills, as per itemized accounts rendered each month to the Honorable Board of Supervisors for their approval. Of the above expense, $867.99 was "enforced eradication" bills paid by the county and returnable to the treasury. Eradication bills to the amount of $953.76, paid by the county in 1905-06, have been collected and turned into the treasury by the District Attorney.

The eradication reports show that 50,501 trees were sprayed or fumigated to destroy red scale, and 327,003 trees were treated with sprays or fumigation to destroy black scale. The inspection force use no time inspecting for black scale.

No valuable results have been derived from the introduction of the black-scale parasite, *Scutellista cyanea,* although it has been well colonized in all the black-scale infested orchards of the county.

Our observations indicate that if it were not for the "off" hatch of scale on the pepper trees during the winter, which furnishes a limited amount of food for the *Scutellista* (which appears to have no hibernating season), it would entirely disappear from our county.

The parasites that were introduced, bred out, and colonized by our Commissioners for red scale have been of small benefit so far, as they were indifferent breeders and had small appetites.

In connection with the inspection work, I will state that the work of the Commission is often handicapped by the resignation of an experienced and valuable inspector, because he can command higher wages in other lines of work. The physical work of an inspector is not hard (except to the eyes), but the work does demand intelligence and some education, and it would be a great help to the work and value of any County Horticultural Commission if the inspectors could be paid, at least in part, for their ability to do intelligent work, as men are paid in other occupations which skill and a knowledge of their work demand. If there was a law for raising the wage of experienced inspectors it would be of great economic benefit to the work of the Commissions and the orchard owners as well.

New orange orchards have been planted in Riverside, Corona, and the San Jacinto foothills on the irrigated lands of Hemet and Valle Vista. A settler on the Hemet tract is experimenting with a ten-acre patch of peanuts, which at the present date indicate a record-breaking yield per acre.

The orange orchards of Moreno show what can be done without much irrigation. At Banning, on the edge of the Desert, they had a fair crop of all kinds of deciduous fruits except almonds, which were several tons short of the usual output.

In the Coachella Valley, below the sea, the farmers would get rich raising cantaloupes for the early markets if the melon-bugs (aphids) and commission ("middlemen") could be exterminated. It is hard to tell which is the most aggravating, the pest that takes the crop just before harvesting, or the one that robs you after you have reason to believe you will be paid for your hard labor.

At the "Date Farm" the trees that look the best are those which have alfalfa between the rows, and there are a few bunches of beautiful fruit on some of the oldest trees.

The rising Salton Sea is getting close to the Date Farm, and no more improvements will be made until the Colorado River is turned back into its old channel. Superintendent Johnson is trying a new leguminous cover crop, which he will be able to report on next year. It is the wild hemp of the Colorado River bottoms. It makes a rank growth of about seven feet in six weeks from planting the seed, and has "nodules" on the roots. This crop may prove of inestimable value to fruit-growers in this section and all similar climates.

In the month of July the Russian thistle was discovered in the southwestern part of the county, and the Commissioners took immediate steps to have it eradicated.

The orange and lemon crops of this county are several hundred cars short of last year's output, but the prevailing good prices for this year have largely made up for the shorter crop, and on the whole the growers are better satisfied.

The pear blight and codling-moth have caused considerable loss in the deciduous fruit belt, but those who are thorough in cutting out the blight and spraying for the worms have raised considerable clean fruit, and are encouraged to keep up the fight.

Good prices were received for peaches and apricots, both dried and green.

The county has never produced many walnuts, as no large walnut orchards were ever planted, but the scattering trees throughout the county are loaded with nuts.

Before closing this report I wish to inform you that the Riverside County Horticultural Commissioners are deeply interested in the introduction of beneficial insects for the destruction of insect pests or the control of the same, and they feel confident that our most efficient State Horticultural Commissioner will succeed in securing many beneficial insects that will be of great assistance to the fruit-growers in controlling the insect pests which they now have to spray and fumigate for.

Respectfully submitted.

H. K. SMITH, Secretary.

SACRAMENTO COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: The County Horticultural Commissioners submit their report of the horticultural conditions of Sacramento County for the season of 1906.

Insect Pests.—There has been no spread or increase of scale insects, due largely to the multiplying of beneficial insects that have been introduced in the past, together with the annual spraying, which all commercial fruit-growers concede is part of the business.

In the past, the spraying has been done as late as possible to catch the peach-moth, which becomes active as the bud begins to swell. Prior to that time the spraying has been done more or less early.

Peach Blight.—Late spraying, with the late, wet springs for the past two seasons, has allowed the peach blight to develop in a very severe form, causing the entire loss of the crop in places. The blight has been noted in a light form many years back, always after a very late, wet spring. The two past springs have developed it to an alarming extent. Realizing the seriousness of the situation, the Board sent out a circular letter to all peach districts inquiring as to conditions, washes used, and results. From all reports received we note late spraying with any kind of wash had no effect. Those who sprayed early in December with a strong Bordeaux mixture (16 pounds of bluestone, 32 pounds of lime, and 100 gallons of water) had perfect results. Early spraying with lime, sulphur, and salt did good work, but the Bordeaux mixture has the preference; a later spraying with lime, sulphur, and salt would be no loss. After the fungus works its way into the bark of the tree, which is done as the season advances, no wash can reach it. With an early dry spring, and free use of the Bordeaux mixture, we hope to save our peach orchards. We note that old trees, and young trees where replanted in an old orchard, are most susceptible. Japanese varieties of plums are affected also.

Pear Blight.—The Board has given special attention to this disease, working with the agents of the United States Department of Agriculture and the State University. Many of the growers club together and hire an expert to keep their orchards free from blight. But with all the careful attention that has been given this work, there will still be quite a loss from butt blight. The growers who have kept the blight well in hand feel encouraged. If no cutting had been done the orchards surely would have been in a discouraging condition. The large growers claim the income is so great that it pays to keep a close watch and cut out the blight in the first stages, thereby losing only the small twigs, which the new growth replaces. This refers to other than butt blight—a condition which nothing will check, as the disease gets into the roots.

The Alexander apple tree is very susceptible to blight, more so than the pear tree, and such cases are very hard to control.

There was a loss of about 3.8 per cent of the pear trees from butt blight last season.

Hop Aphis.—This insect made its first appearance in a mild way last season. This season the development was great, causing such a loss of hops from mildew that the growers have become alarmed. The native ladybird (*Hippodamia*) was very plentiful, but whether enough to keep the aphis in check another season is a question; with a dry season it might be. The two past seasons have been very favorable for the aphis, the vines putting out a very heavy crop, and foliage with the honeydew from the aphis caused the mold. Little or no spraying for the aphis has been done. The growers should equip themselves with spraying outfits for another season.

Pear Scab.—This has spread to sections where it was never known before, the crop as a whole being very scabby. In some few cases where Bordeaux mixture was used freely the results were thought to be improved. We connect the conditions with the late, wet spring, which will improve with a dry spring.

Grape Crop.—Late cold rains cut the crop of wine grapes one half to three fourths, but the increased prices made the net returns about normal. The grapes shipped East netted one fourth to one third less, owing to the lack of color and sweetness. It has been observed that there has been less sugar in all fruits this season, which impaired the keeping qualities.

Nursery Stock.—This comes from Oregon and different counties of the State; all, as a rule, in good condition.

Fruit Crop.—Peaches from ten to twenty per cent of a crop; prunes a full crop; pears medium; grapes one half to three fourths of a yield; apples half a crop; plums and prunes light, some varieties none; tomatoes, on account of late ripening and early frost, a light crop.

Respectfully submitted.

GEO. H. CUTTER, Secretary.

SAN BERNARDINO COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: The past year has produced some new features in our Horticultural work. In 1905, the fall of the year was occupied with spraying and fumigating. Upwards of 76,000 pounds of cyanide were used in that campaign against destructive insects. Besides this, five power sprayers were in operation, using distillate as the means of disinfectant. When the season was over and the field inspected, we found that orchards sprayed were very generally damaged by the distillate. The foliage had dropped to a considerable extent, and the trees showed much dead wood. So bad were the results that at the present writing nearly every spray pump used in the western part of the county is for sale. Orchardists are relying almost entirely on fumigation in the cleaning of their orchards. We shall have use, still, for some of the county's spray pumps in disinfecting for Florida red spider, codling-moth, powdery mildew, and all troubles of deciduous trees.

A new feature in our work this year was the breaking out of pear blight in a number of our apple orchards. Work was commenced immediately to check it, and so closely was this followed up that hardly a vestige of the blight can be found. In some instances the whole top of a tree was cut away and burned. The method used was to cut off every twig or limb showing signs of blight. After each cut, the shears or saws were disinfected by dipping the tools in a weak solution of corrosive sublimate, and each cut on the tree was sponged with the same solution.

Powdery mildew also has caused considerable damage in the apple orchards. Experiments will be tried to see if it can be substantially checked. The first treatment will be given about December 1st. This will be followed by another one in March, using Bordeaux mixture and other fungicides.

We have liberated one colony of the parasite for codling-moth, but as yet the test is incomplete, and we hope to reinforce the colony liberated with another colony at a later date.

We have found it necessary to do some spraying this season for the Florida red spider. We used the sulphur-potash solution, and obtained very satisfactory results.

Scutellista cyanea, as a parasite for black scale, has proved a failure in this county. They eat only the eggs of the scale, and as these are all hatched out by the first of September, the flies are practically starved out. Very few survive, and they are not again in sufficient force to cope with the scale until they have had time to breed two generations. They are usually found quite numerous again in the latter part of the month of August.

Time has thoroughly tested the *Vedalia cardinalis*, and they are always equal to any emergency.

Complaints from orchardists as to soft brown scale or San José scale are seldom heard, internal parasites keeping them thoroughly in check.

The red scale is the worst enemy we have in this county, and we rely entirely upon fumigation for fighting it. It is much harder to kill than the black scale, so much more so that we double the dosage for black scale in fighting the red.

There is such a wide difference of opinion about the dosage in fumigation that a move is under way to have a scientific test made to find out what the proper dosage is for the different scale insects, and the effect of added amounts of water, and sulphuric acid, and so on.

Probably 40,000 citrus trees have been shipped into this county from contiguous counties. To insure against the possibility of introducing pests with trees—pests new to the locality where they are to be planted—

our method has been to have the leaves all taken off and the bodies of the trees scrubbed, using a stiff brush and whaleoil soap—not less than one pound to a gallon of water.

We quarantine entirely against grapevines from any locality known to be infested with phylloxera.

Experience has taught us that it is the height of folly to take continual chances of introducing new pests from locations known to be infested. Such indiscretions have caused California millions of dollars of loss already.

I heard a nurseryman who had *Florida trees to sell* make the statement that the purple scale would not live in Southern California; that if trees were planted out that were infested with this pest, they would not live two years, and he would give $5 each for every scale found after that time. Yet, any one posted in this matter to-day knows that even a Rockefeller could not begin to pay that price for what can be found in Southern California.

With this experience, we say again, in all candor, that it would be the height of folly to relax our quarantine in the least.

In 1905, 2,000 acres of citrus trees were fumigated by our own county outfits, using 200 tents. This season we have more tents and expect to use upwards of 40 tons of cyanide of potassium. It takes fumigation to get results. Our motto is, "Don't try to economize by cutting down the dosage when you have tents on the trees." See that conditions are all right and then hit as hard as is necessary to get good results. Comparatively few realize how hard a tree can be hit without damaging the trees, provided conditions are just right.

Respectfully submitted.

S. A. PEASE,
Horticultural Commissioner.

SAN DIEGO COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: The Horticultural Commissioners of San Diego County have the honor to submit herewith, as provided by law, a report of the conditions of the orchards for the year 1906.

The past year has been one of unusual favor to the growers of citrus fruits. The season just closed produced an average crop of superior quality, which sold in the markets for prices that have made it for the growers the best financial year in our history.

Peaches, pears, and plums were a poor crop, except in some few nooks in the mountains. Apples, apricots, berries, and cherries, about an average crop, of excellent quality. Grapes and walnuts produced a heavy crop, of superior quality.

Great progress has been made during the past two years in the cultivation of early vegetables, such as cucumbers, cantaloupes, and melons, and the outlook is good for a much greater growth to follow.

The rainfall of the year was above the normal, extending throughout the entire season, causing the cereal crop to grow so rank in general that the heads were not well filled. Corn is a big crop; reports are that large fields averaged eighty bushels to the acre.

Oranges have produced about the same as last year, the quality being somewhat improved over other years.

Lemon shipments were heavier and the fruit of finer quality than usual. Prices have ruled higher and the producers are in better cheer than during past years. Many of the lemon orchards that were abandoned during the years of light rainfall are now being brought into bearing, and during the coming season we hope to increase the output.

The condition of the apple and pear orchards throughout the valleys has not improved during the year, the codling-moth practically destroying the crop.

The mountain districts are now marketing an average crop of fine fruit. The apples set in great abundance, but dropped during the months of May and June. The cause is thought to be dampness during the blooming season.

The warfare waged against the codling-moth and the beetle that punctures the apple has been very successful throughout the Julian district the past year. The general opinion is in favor of the dust spray, as it better controls the work of the insect that punctures the fruit than does the liquid spray.

This season for the first time some of the pear and apple orchards of the mountain district were attacked by the apple scab, which caused considerable damage to both fruit and foliage.

No trace of the much-dreaded pear blight has been found in our county. In some localities a form of fungous dieback has done some harm in the apple orchards, attacking occasionally some of the small branches during midsummer, causing them to dieback, but to no serious extent.

Seventy thousand deciduous fruit trees were planted during the past season. Peaches were in the lead, and the industry will soon be well established again. Most of the fruit trees planted came from nurseries in Fresno and Orange counties. A few citrus trees were planted during the year. The stock came from Los Angeles and San Bernardino counties. Some extra fine apple trees were imported from the states of Nebraska and Minnesota, and some peach trees from Missouri.

Thousands of apricot trees have been planted in this county, being furnished by California nurserymen, under the names of Royals and Early Royals, but were propagated in the Eastern states. They have, however, proved a complete failure in producing fruit, seemingly being some strong-growing sort that makes no provision for fruit.

The grape crop was abundant, and the exceptionally fine quality of all varieties has commanded big prices throughout the whole season. There are no diseases of the vine to discourage the industry. The only objectionable feature is mildew, which is readily controlled by the use of sulphur, although we are preparing to plant resistant stock.

The walnut industry, though limited in the county, is profitable. No form of disease has as yet interfered with its development. Quantities of the best nut trees are now sold to nurserymen at prices far above the market price for propagating.

Insect pests, we believe, are gradually diminishing, due to their natural enemies. We have succeeded well in the control of the mealy-bug (*Dactylopius citri*), in both the greenhouses and in the open, with the *Cryptolæmus montrouzieri*. These have proven as great a success with us in San Diego County in controlling this pest as has the *Vedalia cardinalis* in controlling the *Icerya purchasi*. The purple scale (*Mytilaspis citricola*) is well under control in many of our large citrus orchards. The *Rhizobius* family has the credit for this.

All of our olive orchards and many of our citrus orchards are now depending wholly on beneficial insects to control the scale insects, and we are well satisfied with the results. Others, who depend on fumigation, are of the opinion that it is the only practicable means of producing clean fruit. By a few, spraying is still thought to be the cheapest means of controlling orchard pests.

We have found that dusting the citrus orchards with refined sulphur is the best means of controlling the different species of mites. Ground or native sulphur is a failure. Use only refined sulphur in the vineyards, as other grades of sulphur, containing quantities of lime, have ruined the grapes.

I have not noticed that our peach trees are suffering from any form of blight. The orchards throughout the valleys during the several dry years went down, owing to unnatural causes. The industry is now well established again, and new orchards that have had three summers are vigorous, fruitful, and healthy.

This season the Harlequin cabbage-bug (*Murgantia histrionica*) made its first appearance during the early winter of 1905, feeding on cabbage and cauliflower, and doing great damage. The only means of control as yet is by hand picking and burning.

All plants and fruits brought into our county are inspected on arrival.

Respectfully submitted.

F. AUSTIN, Secretary.

SAN JOAQUIN COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: According to your request to this Board for a report on crops, conditions, etc., a full report for the season ending October 31, 1906, is submitted.

Crop Statistics of Deciduous Fruits and Grapes Raised in San Joaquin County for 1906, as reported by Packers, Shippers, and Growers.

Apples, Peaches, Pears, Plums, and Cherries—			
Exported	106 cars or	1,412	tons
Local shipments and consumption		10,650	"
Table grapes—			
Exported	639 cars or	7,668	"
Local shipments and consumption		6,200	"
Wine grapes—Wineries and shipping		127,000	"
Canned fruit—Stockton and others		800	"
Dried peaches		510	"
Dried pears (light crop)		50	"
Dried apricots (light crop)		25	"
Dried prunes		600	"
Dried figs, etc.		25	"
Almonds		125	"
Quinces, pomegranates, etc.		125	"
Berries		20,000	crates

Total, 157,220 tons, 20,000 crates.

Market value, $3,415,470.

Nursery Statistics, showing Fruit and Nut Trees, Ornamental Plants, etc., Raised in San Joaquin County and Imported from Other Counties, in 1906.

Apples	trees	2,600
Pears	"	4,700
Plums and prunes	"	2,500
Peaches (different varieties)	"	17,600
Apricots	"	1,800
Nectarines	"	200
Quinces	"	300
Cherries	"	7,750
Almonds	"	10,450
Walnuts	"	2,150
Olives	"	7,300
Figs	"	450
Oranges and lemons	"	1,175
Grapes	(cuttings and rooted)	1,010,000
Ornamental and shade	trees	2,300
Gum	"	14,500
Palm	"	230
Roses		1,600
Ornamental plants and shrubs		3,500
Currants		200
Gooseberries		250
Strawberries		25,000

Importations of nursery stock were made from the counties of Alameda, Butte, Fresno, Los Angeles, Napa, Placer, San Francisco, Santa Cruz, Sonoma, Stanislaus, and Tehama.

The San Joaquin County Board of Horticulture has employed three and four inspectors during the year, and has covered almost every portion of the county. The condition of the trees and vines is as follows:

Lodi, Acampo, and vicinity are in good condition. Most of the vineyards and orchards are young and well taken care of, besides having a sandy loam soil, where trees are disposed to be free from insect pests.

The orchards in the vicinity of Stockton, and on the Islands, are not quite in such good condition, owing to the many old trees, which need replacing, especially the peach and apple trees. We find the twig-borer and peach blight are the worst enemies here, and the codling-moth on apples. The red spider is not very bad, and there are also very few scales. The apricot fungus, or shot-hole fungus, is quite bad, and also scales on pears. Spraying has been adopted according to the recommendation of the State Commissioner of Horticulture and the advices received from the State University.

On the whole, excepting the twig-borer, peach blight, and pear scab, we find our orchards in better condition than they have been for several years, and by continuous work and persistence on the part of the grower in spraying his trees annually we will soon be practically without any insect pests whatever.

Mildew has prevailed this year in the Lodi district, causing damage to some of the grapes. Also, some damage is reported from thrips, but not enough to cause alarm. In all cases sulphur was quickly applied to relieve the cause.

Grasshoppers did no damage to speak of in this county last season.

Respectfully submitted.

J. N. SOUTHEY, President.

R. C. TUBBS, Secretary.

SANTA BARBARA COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: The Santa Barbara County Board of Horticultural Commissioners herewith presents its annual report for the year ending September 30, 1906, as follows:

Insect Pests and Diseases.—The black scale (*Lecanium oleæ*) and the brown scale (*Lecanium armeniacum*) have become much less troublesome than they were last year, owing largely to the beneficial work of the *Scutellista cyanea*, although on account of the lateness of the season the parasite was somewhat behind time and the scale got quite a start of its enemy; but since June these scales have been decreasing rapidly, until at the present writing very few live scales are to be found where, during the early part of the season, they were abundant.

The red scale (*Aspidiotus aurantii*) has been kept in check by the distribution of the steel-blue ladybird (*Orcus chalybeus*), and in orchards where the scale was a prominent feature on the trees and fruit last year it has now become somewhat scarce.

In two circumscribed localities in the Santa Barbara district the dreaded San José scale (*Aspidiotus perniciosus*) has been discovered and the proper methods for its destruction recommended.

The purple scale (*Mytilaspis citricola*) is still in evidence. In some orchards spraying with distillate and sulphuric acid appears to have been beneficial, but we are anxiously looking forward to the advent of the promised parasite from China.

The cottony-cushion scale (*Icerya purchasi*) made its appearance early in the season in numerous localities, but as the result of collecting and distributing its predaceous enemies (*Vedalia cardinalis* et al.) it is no longer a menace.

In regard to the trees and plants which serve as hosts for the last-named scale, no hard and fast lines can be drawn; for example, a published horticultural article which gave the names of numerous trees upon which the scale may be found, ended by stating that "The cottony-cushion scale is never found on Ricinus plants." In a few days after reading the above statement I found, in the lower part of the City of Santa Barbara, a Ricinus tree covered with cottony-cushion scale, a part of which I sent to San Francisco to feed the *Vedalias* at the rooms of the State Commission.

The principal plant diseases which have presented themselves are walnut blight, pear blight, and root-rot of the apple. In the Lompoc district the pear crop has been a failure, owing to the pear blight. The walnut blight threatened to do serious damage, but moderated, and the walnut crop has turned out good. Apples in the Lompoc district have yielded a large crop, but owing to scarcity of boxes, the growers have not been able to market a large portion of their crop; in some instances the apples are piled under the trees and covered up, awaiting better facilities for shipment.

Exports and Imports of Trees, Plants, and Fruit.—Careful inspection of all imports and exports to and from Santa Barbara district has been continued, and as a result the standard of the fruit market has been raised.

In the Lompoc district the export of deciduous fruits has been carried out, and efforts been made by the Commissioner for that district to exterminate the noxious weeds.

IMPORTS. (Santa Barbara district.)

October 1, 1905, to September 30, 1906.

Deciduous Fruits: 89 barrels, 8,518 boxes, 71 sacks.

Citrus Fruits: 2,036 boxes.

Trees and Plants: 1,383 consignments from different localities, and 1,000 trees from Oregon to Lompoc, Cal. (Among these imports were 1,500 grape-cuttings for planting and 16,000 trees for forest planting.)

Deciduous fruits have been received from Colorado, and from the following California counties: Sonoma, Ventura, Humboldt, Santa Cruz, San Luis Obispo, Fresno, Los Angeles, Santa Clara, Contra Costa, San Francisco, and others.

EXPORTS.

Deciduous Fruits: Very few.

Citrus Fruits: 83,860 boxes.

Trees and Plants: 54 consignments, to the following localities: Texas, Maine, Michigan, New York, Oregon, Washington, Colorado, Utah, Illinois, Victoria, B. C., and Belgium, and the majority of the counties of California.

Respectfully submitted.

LORENZO G. YATES, Secretary.

SANTA CLARA COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: As Entomologist and Horticultural Commissioner for Santa Clara County, I beg leave to submit the following report for the year 1906.

My appointment was made to take effect June 1, shortly after a temporary suspension of the work caused by the earthquake. Owing to the well-organized condition of the office under my predecessor, Mr. Dudley Moulton, I have been enabled to continue the work without any appreciable loss due to the interruption.

The increase in vineyards during the year is about 750 acres. Approximately 408,000 fruit trees have been planted. Among those which show the greatest increase are peach, 13,500; French prunes, 288,000.

The most injurious insects are the peach-tree borer, woolly-aphis, codling-moth, peach-moth (*Anarsia lineatella*), cankerworm, thrips (*Euthrips pyri*), and pear scale (*Diaspis pyricola*).

The peach-tree borer is controlled by digging out the larvæ in the spring before the moths issue and painting the base of the tree with some substance which will prevent them from depositing their eggs.

The codling-moth has been reduced to a minimum, and a large percentage of the fruit saved in most cases where spraying with arsenate of lead has been carefully done. Banding has also proved beneficial.

For the peach-moth, orchardists will spray with lime, sulphur, and salt as soon as the larvæ begin to show activity in the spring.

The cankerworm is common in some parts, but not general over the county. Tree-tanglefoot applied to the base of the tree before the moths issue has proved effective.

The thrips was much less numerous this year than last. This was probably due to climatic conditions and the work of a parasitic fungus which has been found attacking the insect.

The scale insects have given comparatively little trouble in most districts. The parasites seem to be doing good work. The pear scale (*Diaspis pyricola*) is the most abundant, because it conceals itself under the lichen, which must be removed before the scale can be attacked.

The past season has been favorable to the growth of fungi. Among the most common are brown rot (*Monilia fructigena*), prune rust (*Puccinia pruni*), apple scab, and pear scab.

The prune rust has appeared in some orchards and prematurely defoliated trees. We believe that by destroying the fallen leaves, which carry most of the spores, and by spraying with Bordeaux mixture, this may be controlled.

Peach blight has made its appearance, but has not done great damage. Early winter spraying will be used.

The pear blight is not known to be in this county. A careful watch is being kept, and should it appear the best methods known will be employed to eradicate it.

Fruit trees are lost yearly by wood-destroying fungi, many of them undoubtedly being wound parasites. An effort is being made to have all orchardists become familiar with the habits of these fungi, so that they may in great measure protect their trees from them.

Respectfully submitted.

EARL MORRIS, Entomologist.

SANTA CRUZ COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: The Board of Horticultural Commissioners of Santa Cruz County herewith submits its report for 1906.

Owing to a combination of unfavorable conditions which prevailed last spring, our horticulturists have not enjoyed prosperity to the degree to which they are accustomed.

A warm winter caused the deciduous fruit trees to bloom two weeks ahead of the normal period. Continued wet weather during the blooming of the stone-fruits caused the embryo fruit to drop, and a very light crop was the result. The brown rot also made its appearance in some districts and added further damage to the stone-fruits.

With the exception of prunes, prices for stone-fruits have ranged high.

Berries of all varieties have yielded well, and prices have been remunerative.

Grapes in the northern part of the county produced satisfactory returns in both quantity and price, while in the central districts the early predictions of a bountiful crop did not materialize, owing to adverse weather and the development of mildew.

Apples, our leading fruit, fell somewhat short of the normal in yield. A visitation of scab also aided in reducing the output of choice apples. However, our apple-growers are not discouraged with the reverses of the season. On the other hand, the great demand for our product at good prices in the face of a phenomenally large world's crop inspires renewed confidence in the stability of the industry. This confidence is strengthened also by the knowledge that we are now able to effectually hold in check all the insect pests and diseases to which the trees in this locality are subject.

Respectfully submitted.

C. H. RODGERS,
S. N. TRUMBLY,
F. W. HITCHINGS,
Horticultural Commissioners.

SHASTA COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: Our work during the past season has been largely confined to fighting the pear blight; also a careful inspection of nursery stock imported into the county. The pear blight, until the past season, was not very widespread, being confined to the river bottom districts. During the past year it has become general all over the county. The season was very favorable to its spread, and it seemed to take a most virulent form. Sections where it had never been known were as badly affected as any. In some orchards as high as sixty per cent of the trees are in a dying condition. The fight has been most successful in the small orchards, where the careful owner could personally attend to its eradication and knew how the work was to be done.

The red spider did considerable damage to prune trees along the Sacramento River bottoms, but nothing serious resulted from their work, as the growers used a sulphur dust spray which was effective.

There were about 10,000 trees imported into the county the last planting season, consisting of all varieties of fruit, principally peaches and pears. Of this amount about 1,000 were condemned; in most cases on account of root-knot. There were some cases of San José scale on on the stock.

As to the fruit crop in general, it was a fair one. In most localities peaches were light. The Elberta and Muir peaches were, however, about an average crop, as they both seem particularly adapted to the conditions of this district. The pear and prune crops were large. Pears were not of good quality this season. Prunes were about an average with other years.

Our Board is now making the fall campaign against the pear blight, and from present indications there is plenty of work to be done.

Respectfully submitted. GEO. A. LAMIMAN, Secretary.

STANISLAUS COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: The Board of Horticultural Commissioners of Stanislaus County beg leave to submit the following report for the year 1906.

During the past year we have been constantly at work with the fruitgrowers, recommending and assisting in the eradication of scale and other injurious insects and the Russian thistle. We have San José scale, brown apricot scale, cottony-cushion scale, black scale, codling-moth, peach-moth, pear blight, apple and pear scabs, grasshoppers, diabroticas, and other insects which infest garden plants and vines. Each of the varieties of scale bugs seems to have a parasite feeding upon it, consequently we are not damaged much by scale.

Caliephialtes messer, the parasite for the codling-moth, seems to be a failure, as we find no results, nor any of the insects since they were liberated. Spraying is still followed to eradicate the codling-moth.

In the spring of 1904 the pear blight made its appearance over the entire county, and was very bad in places. Cutting out of the blighted limbs was done by most of the orchardists. In 1905 the blight was much less prevalent, but I could see no more improvement in orchards where blight had been cut out than where it had not. This season the blight was more prevalent than any previous year, and indicates that our pear industry is threatened with destruction. It also appears that the blight is equally as bad in uncultivated orchards as it is in well-tilled orchards. There seem to be cases where the blight does not attack the wood, only the leaves and buds; in such cases the young trees have made little growth during the past two years.

The shothole fungus and peach blight did much damage to peach trees that were not sprayed this spring, with the exception of the Muir variety. The trees that were affected lost most of their fruit buds, leaves, fruit spurs, and small limbs. Where spraying was done with lime, sulphur, and salt, the damage was slight, but where orchards are protected by windbreaks, such as high board fences or evergreen trees, the damage was greater than where the orchards were exposed to the north winds. The past season seems to have been more conducive to fungous diseases than usual; even our alfalfa was badly injured by fungus or rust. Apples and pears were badly marked by scab.

The importation of fruit trees and grapevines into our county during the past season was greater than in any previous year, the number reaching into the millions. All trees are inspected upon their arrival. If there are any visible diseases or insects the trees are fumigated, if such treatment will eradicate the insects or disease, otherwise the trees are either returned to the shipper or burned. All trees from out the

State are thoroughly inspected and then fumigated before delivery. We found it necessary to burn a number of shipments, consisting of several thousand trees, that were either affected with root-borers or were from states where the peach yellows exist.

Our county produces excellent almonds, apricots, peaches, plums, prunes, grapes, olives, and figs, also apples, and pears previous to the introduction of the pear blight. In the eastern part of the county, along the foothills, citrus fruits grow to perfection. Some of our grapevines have produced seventy pounds of grapes to the vine at three years old from the cutting, and twenty-seven tons of wine grapes were taken off a six-acre vineyard that was two years old. We claim that the Flame Tokay grape will color earlier and as good as in any other part of the State. Cherries, pomegranates, and walnuts have not been sufficiently grown to determine their suitability for this soil and climate.

Respectfully submitted.

A. L. RUTHERFORD, Secretary.

TEHAMA COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: We herewith submit our annual report and beg to advise that during the past season this Commission has labored diligently and faithfully, principally with the so-called pear blight, and in some instances has been very successful.

To our minds, the pear blight is a serious fruit disease and requires heroic treatment. We shall continue, as in the past, to enforce strict disinfection in every orchard within our domain.

We are not much troubled with the so-called scab or other fungous diseases. After carefully studying the different fungous diseases, and noting the condition of the trees, this Commission is of the opinion that spraying during the fall months, November and early December, is of more benefit in killing insects that are housed in the trees during the warm months, than to allow the insects to live during the winter months and then spray the trees in the spring. We are of the opinion that a strong spray early in the winter before the rains will go far toward killing all foreign diseases, and the early rains will cleanse the trees.

Respectfully submitted.

JAMES FEELEY, Secretary.

TULARE COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: The Board of Horticultural Commissioners of Tulare County has the honor to submit herewith its annual report for the year 1906.

In deciduous trees (peaches, plums, prunes, apricots, apples, and quinces) nearly 3,000 acres were planted; two thirds to peaches of the

Philipps, Tuscan, Muir, Elberta, and Lovell varieties. Prunes planted mostly for resetting. Apricots, apples, and quinces, small plantings for home orchards.

Many thousand vines were planted along the foothills from Dinuba to Porterville. In this section the vines grow wonderfully fast, and produce very early. All raisin varieties, up to this wet year, have shown heavy sugar. Malagas, Thompson Seedless, Emperors, and Tokays have proved splendid bearers and A1 shippers, and we believe the next season will prove this section to be the earliest carload shipper in the State. At that time vineyards will be old enough to produce in car lots.

The raisin crop this year promised to be very large, but, on account of excess of water, dried away one fourth of the estimated crop. We fought mildew with all the sulphur that could be obtained; many vineyardists could get enough only to go over a part of the vines, and a heavy hailstorm damaged a small section. With all these drawbacks, vineyard owners in this county have made money, and are well satisfied. Many tracts of land are already sold for planting this season (1906 and 1907), and many strangers have purchased bearing vineyards and are now taking possession. This county is free from phylloxera and the Anaheim disease, and many old vineyardists from other parts of the State are investing here. We have had a long, hard fight to keep out infested vines, but we believe that vineyard owners are with us, and with their help we can keep out these dread diseases.

The prune crop promised to be the largest ever grown here, in fact it was the largest ever handled, but it dried away from three and a quarter to four pounds to one—many hundreds of tons of small sizes; very short on large sizes. Early in the season offers of 2½c base were made — very few sold. Then base dropped to 2¼c, 2c, and 1¾c. At this date (November 1) 2c base is being offered. We estimate the gross crop at 5,360 dried tons. On hand at the present time, 2,300 tons. Very small per cent of large sizes in French prunes; all large size in Robe d'Sergents.

Apricot crop very light; prices high. Dried peach crop small; prices A1.

Canning peach crop about three quarters of last year; all early peaches and apricots were shipped to Los Angeles and the East. Gross tonnage of peaches (canning, drying, and shipping), 9,370 tons.

The citrus orchards in this county are growing so fast that we find them hard to keep track of, as the planting runs nearly sixty miles along the foothills from the Fresno County line on the north to several miles south of Porterville. Every one in this long strip of country is either getting ready to set out an orange or lemon orchard, caring for a young one, preparing to gather from an old one, or estimating the cost of planting, and testing for water. Land is being surveyed for orange orchards; trees are being contracted for, wells bored and electric lines being run to the different sections of land for power to pump the water on the new orchards.

During the past season we have inspected 123,720 citrus trees, mostly in carload lots from nurseries in the southern part of the State—all clean, fine trees. Also, 221,380 deciduous trees have been inspected; nearly all California grown. Small lots of trees came from Oregon and Washington; also small bales and boxes of trees from Iowa, New York, Alabama, Wisconsin, Missouri, and Nebraska. All shipments were closely inspected.

Many thousand trees and vines were shipped out of this county by our nurserymen. In fact, every tree and vine were sold out early in the season.

This Board and its inspectors devote all of their time during the planting season to watching the importation of vines and all nursery stock shipped from other states.

Peach blight was first noticed in the spring of 1904, but very little attention paid to it, as it was not severe enough to hurt the crop. In the spring of 1905 it showed up very bad in all wet places, and several orchardists did some late spraying, with no good results. This last spring, 1906, it looked as though a fire had run through our peach orchards, touching only the lower limbs. Great drops of gum were hanging from the under parts of the twigs or limbs, and slowly working higher up in the tree. We find that all varieties of peaches and apricots were affected more or less. In orchards that had been sprayed with lime, sulphur, and salt the trees came out in much better shape and seemed to recover much sooner. No one used the bluestone spray as early as December. Many had just finished the last of February. Every peach-tree owner expects to spray, and spray early, this season. We are having trouble in getting bluestone, but hope to procure it before it is too late to do the work.

We have distributed the past season 213 colonies of *Vedalia cardinalis*; fumigated 731 orange trees for yellow and red scales; and condemned seven shipments of trees from Eastern states, on account of the black-knot.

We are having printed a pocket bulletin with instructions for mixing and applying the different formulas of sprays; also, warning against the buying of rooted grapevines outside of the county. We have placed in every freight house and railroad station a copy of the State horticultural law, the plant and inspection law, and our county ordinances.

Respectfully submitted.

C. S. RILEY, Secretary.

VENTURA COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: The Horticultural Commissioners of Ventura County have the honor to submit their report for the year 1906.

We are pleased to be able to report at this time that Ventura County was never so free from black scale as it is at present. This is due to two causes: the very large amount of fumigating done in the citrus districts, and the *Scutellista cyanea.* The past two winters have been very wet; and, back from the coast, the *Scutellista* were killed; as a result, the black scale was much worse than usual. This caused the fruit-growers to purchase several large fumigating outfits, which have been at work constantly for the past two months. Near the coast the *Scutellista* were not killed by the cold and wet weather, and have practically wiped out the black scale.

A recent visit to Olivelands, the largest olive orchard in the county, and for many years the worst infested, shows the trees to be nearly clean, and Mr. Ramsey, the proprietor, says that the *Scutellista* were so numerous this fall that he found thousands of them in the windows of his residence, which is located in this large olive orchard. We prophesy that the black scale will give little trouble in this county in the future, for the *Scutellista* will spread from the orchards which have not been fumigated into those which have, and will keep the scale from ever becoming numerous again,

We have found some more purple scale this season on Ventura avenue, and there is still a small amount of this scale in Santa Paula Cañon. We have been trying a new formula, recommended by the Los Angeles Commissioners, for fumigating this scale. The formula is: cyanide, 1 ounce; sulphuric acid, 1 ounce; water, 4 ounces. We find that we can use twice or three times as much chemicals without injuring the tree, and when so used seems to get all of the scale.

The codling-moth has been bad on the apples this season, and we do not know that the parasite has been established in this county yet.

The principal tree-planting done last spring was walnuts and apricots.

We have very few peaches in the county, and have not discovered any peach blight.

Respectfully submitted.

J. F. McINTYRE, Secretary.

YOLO COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: The Yolo County Board of Horticultural Commissioners was organized on January 3d of the present year. The Yolo Board of Supervisors was moved to action because of the agitation caused by the pear blight—the most fell disease that has ever attacked our pear and apple orchards.

Mr. August Brinck, the chairman of the Commission, divided the county into three sections; each member having his respective territory. Meetings were held and different phases of the disease were thoroughly discussed.

Summing up the situation, we find that where orchards are isolated and in which good work has been done, the disease has been largely eradicated, thus creating strong hopes of ultimate control. We fully realize, however, that a constant warfare must be waged. Some seasons are more favorable than others for its development, and those who do not personally superintend this work are apt to be disappointed in results. At Winters and Rumsey the pear blight this fall is worse than it was last year; this in the face of much work, but work which was not thoroughly done. Along the Sacramento River the situation is very encouraging.

The San José scale is present, as is also the greedy scale. These are controlled by the use of salt, sulphur, and lime wash. The codling-moth was taken care of by the use of paris green and arsenate of lead sprays. Some growers prefer the latter to the former.

Peach blight is not so bad here as in other parts of the State.

There were good crops in all lines of fruit excepting apricots and almonds. Good prices were realized.

Pear scab, causing second-grade fruit, was abundant in some sections this year.

Our county, rich in agricultural resources, is being rapidly developed. The influence of the State Farm, near Davisville, in this county, will add greatly to her prestige. The county has a bright future.

Respectfully submitted.

HAYWARD REED, Secretary.

YUBA COUNTY.

To the Honorable State Commissioner of Horticulture.

SIR: In accordance with prescribed duties, we herewith make to you the annual report of the Yuba County Horticultural Commission.

During the past year this Commission has devoted especial attention to inspection of trees shipped into this section from points abroad;

principal shipments were of deciduous trees from nurseries in this State. One shipment of a few apple trees came from an Eastern nursery, and after a careful inspection was duly passed. Four shipments of apple, plum, and pear seedlings from France were inspected, over two hundred thousand seedlings; all duly passed except one lot of five thousand pear seedlings, which were condemned, on account of being covered with a fungous growth.

A number of inspections have been made in Marysville during the year to ascertain the condition of the orange trees infested with the yellow scale and the destructive mealy-bug. These inspections show that the pests mentioned are well held in check by their natural enemies, the chalcid flies and the ladybirds.

Especial attention has been paid to pear blight in Yuba County. Situated in this county is the well-known New England pear orchard, where the most careful work has been done by Mr. Howard Reed, the owner, in the way of eradicating the blight; and in this connection it may be added that the satisfactory condition of the New England orchard has been brought about by much hard work and the expenditure of considerable money. Let no one imagine it is an easy task to get rid of pear blight. Great difficulty was experienced in treating the New England orchard, but the same results can be obtained on upland orchards with less trouble and expense. Pear-growers ought to make the fight against blight, for it is evident that very many orchards are going to perish through neglect and unskillful treatment, Those who care for their trees, scrupulously following out the rules laid down by Professor M. B. Waite, are sure to reap in due time a rich reward in the high prices that are eventually to be paid for sound Bartlett pears. Experience at the New England orchard proves that summer and early fall work against the blight is the most important; the summer work should be done by experts, as there is then danger of spreading the blight by careless work. Pear blight can not be eradicated, but it can be kept in check by following carefully the Waite system.

This Commission has not been able to obtain any reports on production and shipments from Yuba County for the past year.

The Yuba County Horticultural Commission has recently been reorganized by the appointment of G. W. Harney, of Marysville, W. B. Meek, of Camptonville, and Howard Reed, of Marysville.

Respectfully submitted.

G. W. HARNEY,
for the Commission.

PROCEEDINGS

OF THE

THIRTY-SECOND STATE FRUIT-GROWERS' CONVENTION,

HELD AT

HANFORD, DECEMBER 4-7, 1906.

CONTENTS.

FIRST DAY'S PROCEEDINGS.

Morning Session—

PAGE.

ADDRESS OF WELCOME. By Mayor H. A. Beekhuis, of Hanford 321

PRESIDENT COOPER'S ADDRESS 322

REVENUE AND TAXATION. By Governor George C. Pardee 330

DISCUSSION ON GOVERNOR'S ADDRESS 347

Afternoon Session—

APPOINTMENT OF COMMITTEES 350

TABLE GRAPES. By Mrs. Minna E. Sherman, of Fresno 351

WINE AS A REMEDY FOR THE EVIL OF INTEMPERANCE. By A. Sbarboro, of San Francisco 358

RESOLUTION. Introduced by A. Sbarboro 366

THE FRUIT-GROWER'S AIM. By Howard C. Rowley, of Sacramento 368

APPOINTMENT OF VICE-PRESIDENTS 371

THE GROWING AND USES OF EUCALYPTUS. By Dr. W. H. Miller 372

REMARKS ON COÖPERATION 375

SECOND DAY'S PROCEEDINGS.

Morning Session—

ADDRESS. By F. W. Power, of Chico 378

BENEFITS TO BE DERIVED FROM THE PACIFIC COAST NURSERYMEN'S ASSOCIATION AND THE AMERICAN NURSERYMEN'S ASSOCIATION. By S. A. Miller, of Milton, Or. 381

THE NURSERY BUSINESS IN CALIFORNIA: ITS PRESENT NEEDS AND FUTURE POSSIBILITIES. By Leonard Coates, of Morgan Hill 385

FRUIT VARIETIES MOST POPULAR ON THE PACIFIC COAST. By Prof. E. J. Wickson, of Berkeley 388

SECOND DAY'S PROCEEDINGS—Continued.

Morning Session—*Continued.*

PAGE.

INTRODUCTIONS AT THE PLANT INTRODUCTION GARDEN OF POSSIBLE INTEREST TO NURSERYMEN. By Prof. P. H. Dorsett, of Chico 392

RESOLUTION RELATIVE TO PARIS GREEN 397

REPORT OF COMMITTEE ON GOVERNOR'S ADDRESS 397

Afternoon Session—

RELATION OF THE NURSERYMAN TO THE GROWER. By A. N. Judd, of Watsonville 401

DISCUSSION 403

THE NEED OF A NATIONAL INSPECTION LAW, AND HOW TO SECURE IT. By A. Eckert, of Detroit, Wash. 409

NURSERY INSPECTION LAWS OF CALIFORNIA. By G. C. Roeding, of Fresno 417

RESOLUTION RELATIVE TO AMENDING THE CHINESE EXCLUSION ACT 423

RESOLUTION RELATIVE TO THE DISTRIBUTION OF SEEDS 425

Evening Session—

PROGRESS OF PEAR-BLIGHT CONTROL IN CALIFORNIA. By Prof. M. B. Waite, of Washington, D. C. 426

REMARKS ON PEACH BLIGHT. By Prof. M. B. Waite 432

RECENT WORK IN ENTOMOLOGY. By Prof. C. W. Woodworth, of Berkeley 437

THE HORTICULTURAL COMMISSIONER. By R. P. Cundiff, of Riverside .. 442

ROOT STOCKS FOR GRAFTING. By A. D. Bishop, of Orange 445

BARRING OUT SUSPECTED STOCK. By S. A. Pease, of San Bernardino .. 448

THIRD DAY'S PROCEEDINGS.

Morning Session—

RESOLUTION RELATIVE TO ISSUANCE OF BONDS TO IMPROVE THE WATER-FRONT FACILITIES AT THE VARIOUS HARBORS OF THE STATE 452

HORTICULTURAL USES OF THE UNIVERSITY FARM. By Prof. E. J. Wickson, of Berkeley 453

THE WATER SUPPLY OF THE SIERRA NEVADA MOUNTAINS. By John Tuohy, of Tulare 456

THIRD DAY'S PROCEEDINGS—Continued.

Morning Session—*Continued.*

PAGE.
RESOLUTION RELATIVE TO THE AGRICULTURAL COLLEGE OF THE UNIVERSITY OF CALIFORNIA 464
REPORT OF COMMITTEE ON RESOLUTIONS 464
REPORT OF COMMITTEE ON PRESIDENT'S ADDRESS 469
THE IMPORTANCE OF DRAINAGE IN THE SAN JOAQUIN VALLEY. By John S. Dore, of Fresno 469

Evening Session—

GOOD ROADS, AND HOW TO GET THEM. By A. R. Sprague, of Sacramento 471
RESOLUTION RELATIVE TO GOOD ROADS 481
THE RELATION OF BEES TO THE FRUIT INDUSTRY. By J. M. Rankin, of Chico 482
A FIXED PRICE FOR PRUNES, AND HOW TO OBTAIN IT. By J. Luther Bowers, of Santa Clara 484
REPORT OF CALIFORNIA FRUIT DISTRIBUTORS. By Alden Anderson, of Sacramento 489
REPORT OF COMMITTEE ON TRANSPORTATION 491
RESOLUTION RELATIVE TO TRANSPORTATION FACILITIES 495
REMARKS ON TRANSPORTATION 496
THE UNITED STATES PLANT INTRODUCTION GARDEN, AND ITS VALUE TO CALIFORNIA. By Roland McKee, of Chico 498

FOURTH DAY'S PROCEEDINGS.

Morning Session—

THE FRUIT-GROWER AS A FACTOR IN POLITICS. By Edward Berwick, of Pacific Grove 505
REMARKS ON PARCELS POST. By Prof. D. T. Fowler 510
RESOLUTION URGING CONGRESS TO PASS A PARCELS POST LAW 512
PEACH BLIGHT. By Prof. M. B. Waite, of Washington, D. C. 513
RESOLUTION OF THANKS 523
RESOLUTION OF THANKS TO THE PRESIDENT AND SECRETARY OF THE STATE HORTICULTURAL COMMISSION 523
JOHNSON-GRASS, AND OTHER NOXIOUS WEEDS 523

FOURTH DAY'S PROCEEDINGS—Continued.

Afternoon Session—

PAGE.
METHODS OF INCREASING THE BEARING OF MUSCAT VINES. By Prof. F. T. Bioletti, of Berkeley 524
THE ECONOMIC VALUE OF WILD BIRDS. By W. R. McIntosh, of Fresno 532
A FURTHER PLEA FOR SELECTION. By Leonard Coates, of Morgan Hill 541
THE FRUIT INDUSTRY OF TULARE COUNTY. By P. D. Fowler, of Tulare 544
REPORT OF COMMITTEE ON LEGISLATION 546
THE NEXT MEETING-PLACE 548
VOTE OF THANKS BY THE PACIFIC COAST NURSERYMEN'S ASSOCIATION 549

LIBRARY
OF THE
UNIVERSITY
OF
CALIFORNIA

PROCEEDINGS

OF THE

THIRTY-SECOND CONVENTION OF THE CALIFORNIA STATE FRUIT-GROWERS.

HANFORD, CAL., December 4, 1906.

Pursuant to call, the Thirty-second Fruit-Growers' Convention met at the Opera House, Hanford, Tuesday, December 4, 1906, at 9:30 A. M.

President ELLWOOD COOPER, State Commissioner of Horticulture, called the meeting to order.

REV. J. W. MAUNT, of Hanford, opened the Convention with an invocation.

PRESIDENT COOPER. MR. JOHN ISAAC will act as secretary of this Convention and MR. A. E. BAGLEY, of Los Angeles, will act as official stenographer. The first on our program is an address of welcome by H. A. Beekhuis, Mayor of Hanford.

ADDRESS OF WELCOME.

MAYOR H. A. BEEKHUIS, of Hanford, welcomed the visitors in the following words:

Mr. President, Ladies and Gentlemen: On behalf of the citizens of Hanford I extend to you a most cordial welcome. Hanford has for several years coveted the honor of entertaining the fruit-growers of this State, and now that we have the honor of seing you among us, to meet in convention with the Nurserymen of the Pacific Coast, we can assure you that we will use our best efforts to make your visit as pleasant as hospitality can make it. We welcome you as the representatives of a great industry—of the greatest industry of this State and one that has brought California to the fore as the greatest fruit-producing State, not only of this American Union, but of the entire world, and is bringing a constant stream of intelligent people from the Eastern States to this coast to engage in the profitable and pleasant business of growing fruits.

We also welcome the distinguished gentlemen whose names appear on the program—the men who continually give their time and thought for the betterment of conditions of the fruit-growers, and are always ready to solve the difficult problems that present themselves and threaten to destroy the industry which has been gradually built up to its present level. Judging by the nature of the subjects that will be discussed by you during this Convention, we do not doubt but that you will, when you return to your homes, possess considerable knowledge and information that will be of great benefit to you in the pursuit of your calling.

We further welcome the gentlemen of the Nurserymen's Association, especially those gentlemen who have come from neighboring states and have traveled for hundreds of miles to enter into the discussions.

We also extend a cordial welcome to Hon. George C. Pardee, the Governor of our State, who has come to deliver an address before you, and whose presence with us proves the importance of your convention.

While we realize, ladies and gentlemen, that you have come here for the transaction of important business, we hope that you will find the time and the desire to become better acquainted with this country and its people. Our ladies will tender to you this evening a reception with entertainment and banquet in Odd Fellows' Hall, and the citizens of our neighboring city of Lemoore will entertain you at luncheon Thursday afternoon. For Saturday morning we have arranged an excursion to the Tulare Citrus Fair at Porterville, and we expect that the beautiful orange groves of that section will be a novel and refreshing sight to most of our visitors. If anything has been left undone to make your stay in Hanford pleasant and comfortable, our committees are ready and willing to fulfill your slightest wish.

Again, ladies and gentlemen, I extend to you a hearty welcome.

PRESIDENT COOPER. The next is a response by Hon E. L. Smith. Mr. Smith, I presume, is with the delegation from Washington and Oregon, and has not yet arrived, so we will have to omit that from this morning's exercises.

PRESIDENT'S ADDRESS.

Ladies and Gentlemen: This is the thirty-second Fruit-growers' Convention and the fifth held under the auspices of the California State Commission. The first held by the Commission was in Los Angeles, in May, 1903; the second in Fresno, December 8, 1903; the third in San José, December 6, 1904; the fourth and last in Santa Rosa, December 5, 1905.

This last Convention was, as usual, well attended and of wonderful interest. The essays were of the highest type on fruit subjects.

I regret that I can notmake as favorable a report on the result of the sales of deciduous fruits as for last year. A great deal of the fruit was not delivered in sound condition—was much damaged by decay—some growers attributing the cause to improper icing. The orange crop brought better prices than during the previous year. The lemons sold at satisfactory prices, and the result was very encouraging.

The olive industry remains as reported at the previous Convention, not encouraging for oil-making, but with an increased demand for properly cured pickles. There is a scarcity of good, sound, ripe olive pickles. The demand comes from every part of the United States, without finding a supply.

The nut crop was not heavy, but the prices good. All will be cleaned up and none left over for next season. There is no increase of walnut blight, but a new defect in the nuts, many of the shells being imperfect, having holes or openings that prevent bleaching and making them unsalable as first-class nuts. This defect, without further investigation, would indicate the want of material to make a perfect shell. In Santa Barbara district as much as ten per cent was reported in a few orchards.

The prune crop was fairly good and the present prices satisfactory. Raisins have advanced, selling higher than for several years, owing to a short crop in Spain, caused by continued storms there.

To return to the subject of the refrigeration of deciduous fruits, I was informed by Mr. A. H. Jones, Freight Traffic Manager of the Southern Pacific Company, vice Wm. Sproule, resigned, that the Southern Pacific was building its own refrigerator cars and that during the period of an insufficient number to do the California business, the company would rent cars, but run them as Southern Pacific cars, and that they would be properly iced at every point. This will eliminate the friction and dissatisfaction heretofore existing with the Armour private car line.

The pear blight is very bad in one or two localities, but generally less damaging than during the previous year. Prof. M. B. Waite has returned to California to inaugurate a vigorous campaign against the hold-over blight. Professor Waite is very sanguine as to the result.

The most serious problem that confronts the fruit-growers is labor. Without greatly increased numbers the present area planted to fruit can not be properly managed. California can not progress without an increased number of workers. On the Atlantic shore we had last year an immigration of 1,100,000, and of a class that involves a heavy tax to care for, while the best workers for California are excluded without any organized plan for supplying others.

Pure Food.—I refer to my address at the Santa Rosa Convention, pages 10 and 11; also to the report of the committee, page 190.

As the United States Congress has passed a pure food law, it is the duty of every State in the Union to pass a similar one. The Governor-elect in making his canvass declared himself in favor of a pure food law. Every fruit-grower should urge the assebmlyman and senator from his district to support such a measure.

I will read from the journal "What to Eat," published in September, of serious sickness and deaths caused by consuming poisonous foods: Deaths, 21; sickness nearly 500, in a short period of time. This only includes cases appearing in the Associated Press dispatches and only a small part of what occurs throughout the entire country. Deaths, 1 from eating canned oysters, 3 from wood alcohol, 6 from ice cream flavoring, 2 from arsenic poison in candy, 1 from poisoned beer, 2 from anilin dye, 3 from meats, 1 from butter color, 2 from formaldehyd in milk.

Insect Pests.—The most formidable enemy that the fruit-grower has to contend with will, at an early date, I hope, be decreased sufficiently to cause little damage, and uncertainty of the crop from this cause will be eliminated. We have now in California parasites for nearly every pest that has been a serious detriment to the growers of fruits. The greater part of the past year the effort of the searcher, Mr. Compere, has been directed toward transporting the parasites of the red and purple scales from the Orient to be propagated here and distributed throughout the orchards of California. Many difficulties have occurred in this effort, the great distance and climatic changes destroying the parasites before reaching our shores. Experience, however, has taught us how to overcome the difficulties, and soon we hope to be propagating them in California. The Commission has been devoting every energy to the propagation of such parasites as are now known and demanded by the fruit-growers.

The parasite of the codling-moth has claimed our special attention. The first great difficulty was to get worms; this was mentioned in the address at the Santa Rosa Convention. I was successful in making an arrangement with the Department of Agriculture in New Zealand and had five shipments of worms from that country. We had the disastrous earthquake in San Francisco, which almost destroyed everything in the insectary. What we could gather together we moved at once to Sacramento, where we have a small insectary and are successfully propagating many of the parasites. We need a much larger place. Owing to the wording of the Act appropriating money for the parasitic work we have been hampered, and could not erect a suitable insectary. This we will try to remedy at the coming session of the Legislature. We are now prepared to propagate the parasite of the codling-moth and will distribute throughout the State sufficient numbers to end the destruction of apple and pears by this insect.

I wish to call attention to the fact that parasitic insects will not work successfully in orchards where spraying or fumigating is practiced. There is a transition state between the two methods of destroying the pests. If the orchardist feels that the growing crop must be saved by spraying or fumigation and trusts to the possibility of the parasites getting established for the succeeding year, he will find that he can continue his remedies and make the expense from year to year and scrub and wash his fruit. Parasites will not work successfully under those conditions.

Quite a controversy arose in Western Australia concerning parasitic work in that country, as reported in their Journal of Agriculture, published in September last. One or two entomologists and their supporters contended that it was a useless waste of money. This opposition became so formidable that the government appointed a commission to take testimony and examine into the subject. In the report of the opposition they laid down as the basis of their theories the following:

"This is an old, abandoned scheme, founded on unnatural and impossible working principles, making a vain attempt to force nature to overreach immutable laws contrived and welded by an allwise and beneficent Creator. Our present-day naturalists versed in this knowledge declare this precious scheme to be diametrically opposed to the workings of the sublime laws of nature."

We in California have claimed the very opposite. It is the foundation, the fundamental principle upon which our every effort has relied for success. We believe that in nature everything is balanced, and that it is our duty to study the natural law and seek relief through nature's remedies. The Commission of Horticulture not only decided in favor of the parasitic work, but recommended that one or more competent agents be employed to meet the searcher at various points in foreign countries, and care for and bring to Western Australia the beneficial insects collected, so that the expert searcher would not lose his valuable time in transporting his collections. I had decided upon this method before receiving the Journal, and was happy to learn that others had seen the necessity of such a course.

Some forty years ago, I attended a lecture delivered by Louis Agassiz, the great naturalist, after his voyage to the head waters of the Amazon River, in which he gave the history of monkeys. He stated that there were in the world five distinct species, differing in many respects, different conditions of climate and surroundings producing a different animal, which enabled the naturalist to readily give the nativity. To relate a circumstance showing Agassiz's knowledge of fishes, the captain of a Boston ship, voyaging in the seas off East Africa, caught a fish and took from it a few scales which he inclosed in a letter to the owner of his vessel. The owner put those scales in a letter addressed to Professor Agassiz, without mentioning from whence they came. The Professor, when he received the letter, was lecturing to a class of students at Harvard. He took the scales, went to the blackboard, drew the fish, placed the scales on the drawing, and said the fish from which the scales were taken was only known in East African waters. I mention this to show what can be known of the animal kingdom or of the fishes of the seas by study, investigation, and observation.

To return to insect pests. These differ in different countries, and it is possible for the student and investigator to know the native home of the pest, and there will be found its natural enemy, the parasite.

It has been stated that the destruction of plant life and fruits amounts to more than $300,000,000 annually in the United States. If this be true, it is reasonable to suppose that throughout the civilized world it would amount to more than a billion dollars. It seems to me, therefore, that as nature has provided the remedy for the greatest amount of this destruction, it would be sound financial policy to study the natural law and profit by it.

All of you no doubt have read of the efforts made in Massachusetts in fighting the gypsy and brown-tail moths. Millions have been spent, and yet the danger increases. It is claimed that these moths have spread throughout New England and are in New York and New Jersey; that they can fly a distance of twenty-five miles and are liable to become a scourge in every State of the Union, and entail an expense greater than the cost of the Civil War. I have not been unmindful of this danger and have taken up the matter, not only in arranging for the quarantine, but also in looking up the parasite. Dr. L. O. Howard, chief of the Division of Entomology in the Department of Agriculture at Washington, has charge of the parasitic work in Massachusetts. He paid our department a visit a few weeks ago, and expressed himself as being pleased with our work. He said he proposed to carry on this work in the same manner as it is carried on in California, that he would at once begin the propagation of the parasite of the codling-moth, and that he would furnish every State in the Union with the parasites.

The agricultural journals of the Northwest and Middle West have published much in the past few years about breeding corn and wheat and have stated the great improvement made in the quality of the corn and wheat as well as in the increase in production on measured acres of land.

In fruit-growing in California we have proceeded in a haphazard way, without any care in the selection of seeds. I am fearful that we will have to go back and begin again on scientific principles. The selection of seeds from the matured perfect tree and from perfect fruit raised on new land, might result in trees that would resist the blights now making such havoc in our orchards.

My proposition would be to get the wild pear from the mountain districts of China, where no disease was ever known, or of Europe, and propagate new stock from the seeds. Also to get wild peach seeds from Georgia and propagate new stock. These could be budded or grafted with the varieties wanted, taken from trees where there had been no infection. I have in a very small way, merely for experiment, ordered some wild pears for the above purpose and propose to do the same thing with the wild peach.

It appears to me that it would be good policy for the State to take up this matter. It would not require a large appropriation, and it should be under the control of the State Horticultural Commissioner for two reasons: *First,* the searcher for parasitic insects, who travels to all parts of the world in his line of search, and who knows where these wild fruits grow, could, by a small outlay, have them gathered and shipped to Sacramento. *Second,* the employés of the Commission, who are employed to protect fruit trees and fruits from infection, could safely be trusted with this work. A clause in the Act appropriating money for parasitic investigation, authorizing this work, would be sufficient to make the experiment.

With these few remarks I will close. We have asked for essays on special subjects that will deal with the fruit problems and these essays will be read before this Convention, hence it will not be necessary for me to take up these subjects at this time.

PRESIDENT COOPER. The selection of two vice-presidents is now in order.

MR. A. N. JUDD. Mr. President, I move that their selection be referred to the Committee on Arrangements, and that the names be presented at 1:30 o'clock this afternoon, after recess.

Motion seconded and carried.

PRESIDENT COOPER. We have about fifteen minutes. Suggestions will be in order.

PROF. FOWLER. I move you that a committee be appointed to consider the President's address. The committee usually consists of three, I believe.

PRESIDENT COOPER. How would you have that committee appointed, Professor?

PROF. FOWLER. By the Chair.

MR. H. C. ROWLEY. I second that motion, and I would like, in seconding, to add to the motion that in the report of that committee especial attention be given to the Horticultural Commissioner's paragraph on labor.

The motion was put by the Secretary, and carried.

PRESIDENT COOPER. I might state at this place that Mr. Briggs, one of the members of the State Board of Trade, desires to make some remarks in regard to the next exhibit at Jamestown, and I understand that two of the representatives of that body are present. I will ask Mr. Briggs at this time to take about fifteen minutes to explain the necessity of the fruit-growers making an exhibit at Jamestown the coming year.

MR. BRIGGS. I did suggest to your President that this would be an opportune time to bring to the attention of the farmers the thought that I have in mind with reference to an exhibit at the Jamestown Exposition. The California State Board of Trade, which I have the honor to represent here to-day, need make no apology for its interest in any matters with reference to the farmers or the domestic products of our State.

It has occurred to us, and this thought comes from our Governor, who is here to-day, through letter to the State Board, that we ought, in justice to ourselves and to the products of the State, make an exhibit at Jamestown in 1907. You are well aware that that exposition begins in April, 1907, being the third centennial anniversary of the first landing of white people on the Atlantic coast. It is therefore a historical matter; and aside from the patriotic sentiment that we all feel, there is a selfish sentiment which we ought to and should recognize. No one who visited the National Irrigation Convention can help feeling that the patriotic sentiments expressed there must go throughout this country, and that every man and every woman who feels an interest in the nation, should, so far as they are able, attend the Jamestown Exposition.

But bringing it down to ourselves, since the fire and the earthquake on the 18th of April of this year, San Francisco and the State of California at large have suffered and are still suffering from false reports. These reports are spread broadcast, and are, whether we know it or not, working injury to the advancement of the State. It has seemed to us, therefore, that this was a fitting time for the people of California to show their faith in the State and exhibit the products which we are growing; to show to the world—not only to the United States, but to the world—that we have a country equal to any under the sun, and that we have faith in the future of San Francisco; that we have faith in the future of our State.

Now, Mr. Chairman, I want to say that this can not be done except by the employment of money. The exhibit at St. Louis, I believe, cost $130,000. The appropriation for Portland was very considerably less. It may not be necessary for us to have $130,000 at Jamestown, but we should, in justice to ourselves, favor an appropriation by the Legislature which will enable us to make a suitable exhibit at Jamestown in 1907. My own impression is that that exhibit might be made, in view of the fact that we have a large collection of articles which were used at St. Louis and at Portland, for a very much less sum than was required at St. Louis. And I would say in passing that possibly $50,000 might suffice for that purpose.

Now, I want to make a motion that it is the sense of this Convention assembled that an exhibit at Jamestown, Virginia, in 1907, should be made by the State of California, and that we favor and will work for, so far as we can, individually and jointly, an appropriation for that purpose, which shall not be less than the sum of $50,000.

Motion seconded and carried.

PRESIDENT COOPER. I now have the pleasure of introducing to you his Excellency, the Governor of the State of California. (Applause.)

GOVERNOR GEORGE C. PARDEE. *Mr. President, Ladies and Gentlemen:* As his honor, the Mayor, so well said, the industry which you represent is the most important of any in this great State of California, and that, in a State of this size and a State having so many important industries as California has, is saying a very great deal; but, as you perhaps appreciate more than I, the industry is to-day merely in its infancy. This great valley, stretching from Bakersfield to Redding, should have, and will have—not perhaps in our time, but will have—from five to six million happy and contented people living within its borders, and those people will be dependent for their living and for their wealth—for they will be a wealthy people in their time—entirely upon the horticultural interests which you here to-day represent. And therefore, I say again, it is the most important industry which the State of California has or can have.

I am especially pleased to be here to-day, Mr. Mayor, in the city of Hanford. Two years ago I was here and had the pleasure of visiting the county fair and saw there the products of the county of Kings. I was, I am free to admit, amazed at the variety and the size of the products exhibited at that fair; and I am here to-day, Mr. Mayor, to express my thanks and the thanks of the stricken people of the city of San Francisco for the kindness, the benevolence, and the fraternity shown by the people of the city of Hanford in the county of Kings when the flames were sweeping over the city that they laid in ruins at their feet. This city did, I think, more per capita to relieve the distress in the city of San Francisco than any other part of this State or this Union, and that, ladies and gentlemen, is saying a very great deal. (Applause.)

I am here to-day to speak not upon horticultural subjects. I took the liberty of asking the President for permission to appear and talk to you about revenue and taxation. That is perhaps a dry subject, and is perhaps one which should not be spoken of before a fruit-growers' convention such as this; and yet I am going to make no apologies for doing it, for, although you are fruit-growers, you are citizens of California and you are taxpayers, and, therefore, every one of you is interested, greatly interested, in the subject of the revenue and taxation system of this State. It is a matter which appeals not only to the hearts but to the pockets and the pocketbooks of every man, woman, and child in this State; and if the women and the children have not the pocketbooks, their husbands and their fathers have, and therefore the matter is of still more importance to him who holds the pocketbook.

Now, I suppose I may, as the subject is rather a complicated one, be pardoned if I use some manuscript in keeping strictly to my text and in presenting this matter in an intelligible, intelligent, and consecutive way, and therefore bringing the matter into such a shape that when I cease I sincerely hope that this Convention will take up the matter and discuss it, and if there is anything wrong with the system proposed by the State Revenue and Taxation Commission, I hope that it will be mercilessly exposed here upon this floor, because all that that commission wants, and all that the people of this State want, is a better system of revenue and taxation than we have, and going farther than that, the best possible system of revenue and taxation which can be devised. Therefore, I sincerely hope that the gentlemen and ladies of this Convention will take it upon themselves to criticise and flay mercilessly, if they can, anything which, as the representative of the Commission on Revenue and Taxation, I shall here to-day put forth.

REVENUE AND TAXATION.

By GOVERNOR GEORGE C. PARDEE.

Mr. Chairman, Ladies and Gentlemen: It may, at first glance, be considered out of place for me to address you on the subject of the proposed changes in the revenue and taxation laws of this State. But you are all taxpayers and citizens of California and, therefore, interested in anything that promises to redound to the benefit of the State and its people. For that reason, then, if for no other, I shall not apologize for addressing the California Fruit-Growers' Convention on this subject.

You are all aware that our present system of assessment and taxation, especially for State purposes, is very unsatisfactory. For instance, about 85 per cent of the taxes paid in this State is borne by real estate, while only about 15 per cent is paid on personal property. Yet no one imagines for a moment that the personal property in this State amounts to only 15 per cent of everything of value we possess. The personal property of the farmer, his horses, chickens, swine, plows and the like are all taxed, because the assessor can easily find them; but the greater part of the personal property in the cities escapes taxation. In 1870, personal property was 39 per cent of the entire assessment roll; in 1905, personal property was only 18 per cent of the entire roll. Yet, in 1870 there was nowhere near the amount of personal property in California that there was last year.

Not only has the percentage of assessed personal property fallen off during the last thirty-five years, but, strange as it may seem, its actual assessed valuation has not increased. For instance, in 1872, personal property was assessed at $220,000,000. Until 1903, a period of thirty years, the assessors were never able to find that amount of personal property again. Yet, during these same years the aggregate assessment roll rose from $600,000,000, in 1872, to $1,600,000,000 in 1903. In 1872 the State had a population of something like 575,000; it now has at least a million and three quarters. Over one million increase in population has added practically nothing to our assessed personal property; and practically all the increase in taxation has been borne by real estate.

In 1880 the assessment of personal property was $201 per capita. In 1890 it was $139 per capita. In 1896 it was $122 per capita. In 1880 the assessed valuation of real estate was $523 per capita. At present it is $840 per capita. In other words, the per capita of assessed personal property has decreased 38 per cent, while the assessed per capita of real estate has increased 60 per cent—which is, of course, absurd. For everybody knows that, with the increase in number and size of our cities, with the increase in per capita real estate assessed valuations, there must also have been a great, if not an equal, increase in the per capita value of personal property in this State. Yet the assessment figures show that, per capita, we have much less personal property now than we had forty years ago.

Our taxation and assessment laws require that money and solvent credits shall be assessed and taxed. In 1872 the assessors found $111,531,623 of money and solvent credits in the State. Thirty-two years later, in 1904, there were only $77,000,000, about two thirds as much, of such property assessed, in spite of the fact that our population had increased nearly three times. Everybody knows this is absurd.

According to the assessment returns our people have at present only $13 worth of furniture apiece, for each man, woman, and child in the State, hardly enough to buy a bed and bedding. Absurd, of course. And the worst part of it is that it is safe to say that the greater part of this assessed valuation falls upon the farmer, whose land is already taxed very high.

In 1860 the State collected for its own uses a little less than $900,000. It collects now, including the railroad taxes, which latter are collected by the State and turned over to the counties, nearly $8,000,000 in taxes. Since 1860, therefore, the burden upon the individual of taxation for State purposes has increased over ninefold; while our population has increased a little more than fourfold. Besides the amount mentioned above, the cities and counties collect, for their own uses, about $24,000,000 more, making a total of $32,000,000 paid in taxes in this State.

The State derives its annual revenues from the following sources and in the following sums, in round numbers, exclusive of money collected by the State and turned over to counties:

The ad valorem property tax	$6,800,000 00
Poll tax	460,000 00
Inheritance tax	300,000 00
Tax on insurance premiums	200,000 00
Annual franchise tax	300,000 00
Miscellaneous fees	300,000 00
Collections by State boards and institutions	200,000 00
Earnings of State property and investments	940,000 00
Total State revenues	$9,500,000 00
Out of this the State pays to public school districts and for the support of the University, the five normal schools, farmers' institutes, etc., in other words for education	$5,000,000 00

In other words, the State pays out over half its income for education, leaving but $4,500,000 for the support of the State government and its many, many institutions.

Let us see how the burdens of State taxation are distributed, taking, for instance, the farmers. The United States Census Bureau gives as the total value of California farms, including improvements, buildings, implements, and live stock, the sum of $796,527,955. This property was assessed, for purposes of State and county taxation, at $474,731,497, or about 65 per cent of its real value, and paid State and county taxes in the sum of $8,265,000. In addition to this, California farmers paid something like $765,000 more in personal property taxes—making a grand total of something over $9,000,000 paid in direct ad valorem taxes by California farms and farmers.

If you will remember, it was shown above that the total ad valorem taxes, State, county and municipal, paid in this State is about $32,000,000. It will thus be seen that the farmers, although they pay no city taxes, nevertheless pay, in State and county taxes, nearly 29 per cent of the whole amount of taxes, State, county and municipal.

As we saw a moment ago, the total value of farm property in this State is $796,527,955, assessed, for State and county purposes, at $474,731,497, or about 65 per cent of its real value. The $9,000,000 of State and county taxes paid on this valuation is 1.14 per cent of its real value. The net value of our farm products was, deducting the farmer's compensation and the compensation of those members of his family who work with him, $91,491,866, which is about 11.5 per cent of the real value of all the farm property in the State. The taxes paid on the property are 6.85 per cent of the gross returns, and the per cent of taxes to net returns, including farmer's own compensation, is 9.88. In other words, the farmers of California pay taxes which are equivalent to a tax on net income of about 10 per cent.

No other industry and no other equally extensive class of property in California bears such a burden of taxation.

Let us compare briefly the burdens of taxation borne by the farmers and the manufacturers of California, the data being taken from the Census returns:

	Manufactures.	Agriculture.	Per Cent Total Capital.	
			Manufactures.	Agriculture.
Total capital	$205,395,025	$796,527,955	100.0	100.0
Land	34,735,416	630,444,960	16.9	79.0
Buildings	22,562,385	77,468,000	11.0	9.7
Machinery, etc.	62,440,759	21,311,670	30.4	2.7
Other assets	85,656,465	67,303,325	41.7	8.5
Assessed value	63,500,000	474,731,497	31.0	65.0
Taxes	1,049,932	9,030,000	.51	1.14
Gross product	302,874,761	131,690,606	147.0	16.5
Net product	52,172,862	91,419,866	25.4	11.5
Per cent of gross product paid in taxes			.346	6.86
Per cent of net product paid in taxes			2.01	9.88

In other words, manufactures pay one half of one per cent on their capital in taxes, while farms pay nearly two and a third times as much, or 1.14 per cent on their invested capital. Manufactures pay about one third of one per cent of their gross incomes in taxes, while farms pay about twenty times as much, or nearly 7 per cent of their gross incomes. Manufactures pay 2 per cent of their net incomes for taxes, while farms pay about five times as much, or nearly 10 per cent.

If manufactures are allowed 10 per cent on their capital as a fair return on their investment, then, on the average, manufacturers should pay 2.9 per cent on gross earning, instead of the one third of one per cent really paid, to equal which would only be allowing farmers a return of 4.75 per cent on their capital.

To make a comparison from another standpoint: The Census estimates that the 145,801 farmers in this State earned, on the average, $499.70, in 1899; while the 113,155 manufacturers earned, on the average, $870 each, nearly twice as much as the farmer, while paying for taxes only about one twentieth as much of their gross incomes as the farmers do.

It would seem then, that, on a per capita earnings basis, manufacturers could afford to pay nearly 75 per cent more taxes than could the farmers. As a matter of fact, the average farmer pays twenty times more taxes, based on gross income, than does the manufacturer.

The farmer pays, on the average, $50 per capita in taxes on an income of $500; while the average manufacturer pays $17.50 in taxes on an income of $870. The farmer pays 10 per cent of his income, while the manufacturer pays but 2 per cent of his.

Other illustrations of the inequality of taxes could readily be given. The above, however, will, at this time and place, I think, suffice.

The average total tax rate levied on property outside incorporated cities and towns is $1.75 per $100 of assessed valuation.

The average total tax rate levied on property inside incorporated cities and towns is $2.10 per $100 of assessed valuation.

The rates average 1.14 per cent of the full cash value for country property, and 1.25 per cent of the full cash value of the city property on the rolls.

The following table will illustrate the percentages of taxes paid by different classes of corporations in this State:

	Per Cent of Taxes to Capital.	Per Cent of Taxes to Gross Earnings.
State commercial banks	.65	.....
Savings banks	1.02	.....
National banks	.20	.....
Railroads	.65	3.64
Street railroads	.605	4.624
Express companies	.14	.514
Telephone companies	.52	2.073
Telegraph companies	.33	3.06
Light, heat and power companies	.58	3.03
Farmers	1.14	6.86

In other words, the average corporation pays for taxes 0.52 of one per cent of its invested capital; while the average farmer pays about two and one half times as much, or 1.14 per cent. The farmer pays 6.86 per cent of his gross earnings in taxes, while the average corporation pays about 2.78 per cent, or about one third as much.

It will thus be seen that the burdens of State and county taxes are unequally distributed—something that we have all known for a long time. But this inequality is not so much the fault of the county assessor as it is the fault of the system. The latter, and not the former, is to be blamed.

The last regular session of the Legislature created a commission to examine into the matter of revenue and taxation and formulate some scheme by which the burdens of at least State taxation may be regulated and equalized. That commission, composed of Senators Curtin and Ward, Assemblymen Treadwell and McCartney, Professor C. C. Plehn, of the University of California, and the Governor, has been hard at work for two years; and the results of its labors are set forth in a preliminary report. The final report is in the hands of the State Printer and will soon be ready for distribution to all who will write to Professor Plehn at Berkeley for it.

The following are the conclusions of the commission in regard to the faults of the present system of taxation:

1. In general, the present system of taxation does not meet the demands made upon it. It is antiquated, having been adopted fifty years ago, and has not been revised to keep pace with modern conditions.

2. It is full of inequalities, which impose a handicap on the growth of the State, a handicap which only the vigor and inexhaustible energy of our people can carry. These inequalities twist and distort our industries and prohibit a symmetrical development of our resources. They place an undue burden upon agriculture especially; the foundation of our wealth, the one industry which most fully exploits the great natural resources of the State.

3. The taxes paid by farmers in California are equivalent to an income tax of 10 per cent. This is in contrast to many other industries; for example, the taxes paid by manufacturers, which amount only to 2 per cent on income. The persons engaged in agriculture, with an average yearly income of about $500, pay $50 per capita per annum in taxes. The persons engaged in manufactures, with an annual average income of $870, pay $17.50 per capita per annum.

4. Our chief tax, called a general property tax, has in fact become a real estate tax. Only from 15 to 18 per cent of the entire taxes are levied on personal property.

5. The amount of personal property on the tax rolls to-day is hardly larger than it was in 1872.

6. Money and credits escape taxation almost entirely. Our laws in regard to the taxation of this class of property are full of absurdities and utterly unenforceable.

7. National banks pay no taxes at all, except on real estate, of which they are not permitted to hold much, by the provisions of the Federal laws.

8. State commercial banks, subject to our tax laws, are badly handicapped by the competition of the untaxed national banks. Many of them have become national banks partly for the reason that they would not then be subject to taxation.

9. State commercial banks, to live at all, in face of this competition, are forced to evade taxation whenever possible and are hampered in their investments by unwise provisions of our tax laws.

10. Savings banks, which harbor the savings of the workers, and which are, in many states, granted special rebates in taxation on that account, are the only class of banks which pay their full quota of taxes.

11. "Equalization," so called, does not equalize, and in the nature of things, can not equalize. After the officers have exhausted their best efforts in this direction there are inequalities—glaring ones—between real estate and personal property; between different classes of personal property; between county and county; between city and city; between city and country; between man and man. All of which are rarely removed and often intensified by so-called equalization.

12. The original inequalities in the assessment are intensified by the constant piling up of tax on tax on the same base. If a city has a rate of $1, which may be "reasonable" enough, there often comes on top of that a county tax of another $1, a few special school taxes, or a sewer tax, or a tax for bonds, or a levee tax, or a drainage tax, etc., etc., until the effects of any inequalities in the original assessment have been multiplied anywhere from two to five fold. Aggregate tax rates falling on city property range from $1.65 per $100 to $5 per $100 of assessed valuation.

13. Counties with relatively undeveloped resources often have very high tax rates on relatively high valuations, while some of the richest counties enjoy a low tax rate on low valuations.

14. The present system takes the revenue derivable by taxation from large general organizations, like the railroads, which revenue belongs by right to the people of the State at large, and distributes it most inequitably among the local divisions of the State which have no proper claim to it whatsoever.

15. Under the present system it is impossible to adjust the burden of taxation equitably between different classes of corporations.

16. Our present system is a "school for perjury," puts a penalty on honesty and pays high premiums for dishonesty.

Our present system is so embodied in our Constitution that it can not be bettered without a constitutional amendment.

In order to equalize, as near as may be, the burdens of taxation, the commission recommends as follows:

1. Separation of State from local taxation as to sources of revenue. This is the first step in reform. Complete separation implies that the State shall collect its revenues from sources other than a direct levy on real and personal property of individuals, leaving to the counties and cities the exclusive right to tax such property for local purposes.

This will take the burden of direct State taxation off real estate, and save the owners of real estate over $3,000,000 annually.

It establishes, at once, home rule in matters of local taxation.

It abolishes, at once, any necessity for equalization between counties, and cures the evils State equalization fails to reach.

The property selected for State taxation shall be exempt from local taxation.

Separation, while not a remedy in and of itself, except for the evils arising from the breakdown of so-called equalization, opens the way for a proper classification of the subjects of State taxation, and makes it possible to tax each class with a greater approximation to equality than is possible without it.

2. That an absolute divorce between State and local taxation shall be the ultimate aim, and that as nearly complete separation as possible be attained at the very outset.

3. That the State derive its revenues from the following sources:

(*a*) *Old sources continued.*

(1) A poll tax.
(2) An inheritance tax.
(3) A tax on insurance premiums.
(4) An annual franchise tax on corporations (modified and made proportional).
(5) All fees now collected.
(6) All collections by State institutions (some of which may be increased).
(7) All earnings of State property and investments.
(8) The revenue from sale of State lands.

(*b*) *New sources.*

(1) A gross earnings tax on railroads; street railroads; express companies; car companies; light, heat, and power companies; telegraph and telephone companies, at rates fixed for a period of years by constitutional enactment, after which time they may be amended by the Legislature, but not more frequently than shall be determined by law.

This tax is to be in lieu of all other taxes except taxes on property not necessarily used in the operations conducted by the companies, and excepting, also, any so-called "taxes"* paid as a consideration for the grant of a franchise. The counties and cities would, therefore, be forbidden to tax this class of corporations.

The rates of the gross earnings tax should be fixed in the first instance by determining what percentage of the gross earnings will normally equal 1 per cent on the value of the corporate holdings, determined by its gross revenue-producing capacity.

A simple and logical method for computing this has been devised by the commission, and the data necessary to determine the rates have been compiled.

One per cent of the value is deemed a fair tax rate on real estate and other property on the tax rolls, and the popular demand for "equal" taxation makes it necessary to find a rate on gross earnings which shall be as nearly equal thereto as may be.

(2) A tax on the shares of capital stock of all banks at 1 per cent of the book value of the stock. The book value is the sum of the paid-up capital and the accumulated surplus and undivided profits.

---

* Bonuses or fees.

This tax, like the gross earnings tax, is to be in lieu of all other taxes on the banks, except taxes on real estate, the assessed value of which is, however, to be deducted from the capital before the 1 per cent rate is applied. Cities and counties would be deprived of the right to tax banks except on their real estate and mortgages.

(3) A tax at the rate of 1 per cent on the assessed value of all corporate franchises of every sort, not covered by the above mentioned taxes, such franchises to be valued by the State Board of Equalization. This tax, also, would be in lieu of local taxes on such franchises, excepting, of course, so-called taxes paid as part of the consideration for granting the franchise.

On looking up the legal aspects of the matter the commission found as follows:

The Constitution expressly prohibits separation, by declaring that "No county, city, town, or other public or municipal corporation, nor the inhabitants thereof, nor the property therein, shall be released or discharged from its or their proportionate share of taxes to be levied for State purposes, nor shall commutation for such taxes be authorized in any form whatsoever." (Sec. 10, Art. XI.)

Other passages can be interpreted so as to make the same restriction.

The Constitution has, however, a most liberal clause permitting an income tax. "Income taxes may be assessed to and collected from persons, corporations, joint-stock associations, or companies resident or doing business in this State, or any one or more of them, in such cases and amounts, and in such manner, as shall be prescribed by law." (Sec. 11, Art. XIII.)

Under this provision it is clear that the State may levy an income tax, not only upon its citizens in general, but upon any class of corporations, or, possibly, even upon any one corporation. This is altogether the broadest provision of the Constitution relating to taxation. It places almost unlimited power in the hands of the Legislature.

It would be perfecfly possible to provide a system of State revenues under this grant of power.

The commission believes, however, that it would not be wise to take advantage of this section.

A *general* income tax is un-American. Our people have so much respect for labor that what is won by honest toil is regarded as sacred and not to be reduced by direct taxation. Sixteen states have tried the income tax. In every case it was a failure, being evaded, disliked, laxly enforced, and yielding small returns. Virginia, the only State which made any success with it at all, and that a small one, has recently, by constitutional convention, adopted the general plan proposed by this Commission.

A *special* income tax on selected classes of corporations, in addition to the taxes now paid, is a possibility under the Constitution, and a possibility which this commission recommends shall stand. But the commission does not believe that a resort to such drastic methods at present is either necessary or wise. The necessary reforms can be accomplished in other ways.

The commission has in preparation a constitutional amendment which will make it possible to accomplish the general results aimed at.

This amendment proposes:

1. The repeal of Section 10 of Article XI. This section, quoted above, prohibits separation.

This section serves no good purpose and never has served one, having been copied from a provision of the Missouri Constitution, which was widely copied in other states. It has no bearing on other provisions of our Constitution.

2. The entire revision of Article XIII, which is the chapter or article bearing on revenue and taxation.

The revision is to accomplish the following results:

(1) To eliminate or modify those provisions which might be held to prohibit separation of State from local taxation.

(2) To enumerate the subjects of taxation to be set aside for the exclusive use of the State, and to specify the method of their taxation.

(3) To bring all the exemptions now scattered through several sections into one.

On the question of separation of State taxes from municipal and county sources of revenue, the commission's argument is as follows:

The separation of State from local taxation as to sources of revenue has come to be generally recognized as the one feasible pathway for tax reform.

As this commission uses the term "separation of sources," it means that the counties and local governments shall tax only the private or individual real estate and tangible property within their boundaries; property, that is, which is clearly and distinctly localized. This class of property has a distinctly local situs and benefits obviously and directly by local government. Upon this class of property there ought to be no State tax. The State, on the other hand, should tax all those industries and classes of property sometimes called "corporate" to distinguish them from the "private or individual" industries and properties. Such property does not have, in the same sense, a local situs; it extends over many communities, serves all, and all contribute to its income. Steam and electric railroads, telegraph and telephone companies, express companies, insurance companies, banks, trust and loan companies, light, heat and power companies, and even certain manufacturing and trading companies with branches in different localities, all of these have no distinct local situs, as does a piece of land, or a business block. The characteristic of all such corporate enterprises is that the value of the business which they carry on in any particular municipality is more or less intimately dependent upon the business carried on by them in one or more other municipalities, rural or urban, and can not, therefore, be properly estimated or taxed in any one place, or even in a series of places. Such property and industries are general. They belong to the people of the State as a whole, not to any particular community in which by accident their rails, wires, or offices may be.

The general, non-local character of corporate property is so obvious that it seems almost superfluous to argue that the taxes thereon do not belong to the localities. But as this idea is comparatively new in practice it may need illustration. A carload of butter and cheese may be shipped from Humboldt County to New Orleans. On its way it will pass through many counties. We should hold it robbery if each county erected toll-gates and collected tolls on that carload of Humboldt products. But that is practically what we allow when we permit, as we practically do, the counties to tax the railroads. Or, again, a vineyardist in Napa may ship a cargo of wine to London; a San Francisco bank buys the bill and "finances" the operation. San Francisco in taxing the banks virtually levies a toll on the Napa vineyardist's goods. Every year the banks bring in large sums of money to "move the crops." This money goes all over the State, even into localities where there are no banks. Every producer in the State contributes to the profit which the banks make on the transaction. Why should this business be taxed only in San Francisco, Stockton, Sacramento, or Los Angeles? The business is general, and the taxes on it should be for the support of the State government, which represents all the people and all parts of the State alike. Does the fact that San Bernardino County, Nevada County, and Siskiyou County sit at the gateways through which the railroads enter the State give them a right to tax every yard of cloth, every box of crackers, every plow, and all the other multitudinous wares which the people of this commonwealth bring in?

The right to do business that is enjoyed by corporations is a privilege granted by the State, and not by the cities or counties. Therefore, any tax that may be levied upon the revenues derived from the enjoyment and use of the State privileges used by corporations, especially public-service corporations, ought to be paid into the State treasury for the support of the State government, from which the privileges are derived, rather than into city and county treasuries.

Obviously there is a perfectly clear line of demarkation between property local in character which should be subject to local taxation, and property or industries general in character which should be subject to general or State taxation.

To accomplish separation it is necessary to define clearly and sharply the boundary line between State and local powers of taxation. This boundary line having been once defined, neither of the two parties ought to trespass upon the territory set apart for the other. It implies that there shall be an end to the everlasting piling up of tax on tax on the same subjects or the same foundation, which is the bane of our present system of taxation.

Separation will give the counties substantial home rule in matters concerning their own taxation, and to the same extent there will be home rule in matters concerning city taxation. Within strictly defined limits the county, or the city, should be permitted to determine its own policy concerning the raising of revenue. This does not preclude general laws intended to bring about a certain amount of uniformity as to methods, but it does preclude that constant deference to the effect of State or other taxes which tends to divert the attention of the assessing officers from their primary duty, which is to establish uniformity and equality of taxation between man and man. It is indisputable that separation would abolish the chief incentive to and cause for undervaluations and remove the chief source of the existence of discriminations.

Separation would at once abolish all the evils which "equalization" is intended to prevent, but which it unfortunately fails to remedy.

The crude assumption that each and every interest should be taxed in the same way in proportion to the property which it uses is one of the fundamental iniquities of our present system. This it is which prevents us from taxing each interest in accordance with its ability to pay.

The theoretical principle for the separation of State from local taxation is found in part in the natural distribution of functions between State and local governments. The activities of the local governments, such as the protection of property by the police, the fire departments, the local courts, the construction and maintenance of roads, streets, bridges, and the like; the provisions for schools, the care of the sick and of the poor, redound distinctly, directly, and peculiarly to the benefit of local real estate owners, or local industries, and enhance and sustain the value of real estate and of other tangible property in the localities. This has always been the ground for making local government expenses a local charge. Separation makes no change in this respect, but it would relieve local property from State taxes and from the expenses of general activities, the benefits of which are not directly traceable to the activities of the local government.

In the counties, outside of the cities, the chief local industry is agriculture, and it seems peculiarly fitting that the local industries should bear the expenses of its own protection and support the local expenses. There is probably no better way of apportioning the taxes among a group of farmers for the support of the charges of the local government than by the taxation of real estate. The property tax originated as a neighborhood tax, and works best when used to apportion neighborhood charges among neighbors. It can be made effective only among a group of persons who know each the other's affairs to a large extent, and where deception and concealment are not easy.

In cities it is the growth of the city that, to a great extent, gives value to real estate. This may be admitted without going the full length of the claims of the single taxers, that it is the activities of the city alone which give value to real estate. From either point of view it seems proper that such property should bear the greater part of the expenses of the city which creates its value. Strong arguments have been advanced in support of the contention that the local expenses should be *limited* to the amount which the local real estate can afford to pay;

whether these arguments are valid or not, they point the conclusion that real estate should pay the local expenses.

On the other hand, all the activities of the State are broad and general. This is uniformly recognized in the provisions now found in almost all State constitutions prohibiting local or special laws. The duties of the State are mainly legislative. It provides a uniform code of laws for its entire territory. It provides laws under which business is conducted. It grants charters to industrial and other corporations. It administers such public institutions as are in no sense local in character. In general, the State cares for all those interests that are too broad or too large for the local governments to handle.

Corresponding almost precisely to the general activities of the State government, we find the properties and business of the great public-service corporations which pervade the whole State, such as the railroads, the telegraph and telephone companies, the express companies, and, of late, the light, heat, and power companies, which have spun their wires like spiders' webs over so many communities, or the insurance companies and the banks, whose business is in no sense confined to one locality. These industrial corporations are distinctly and peculiarly the creatures of the State, and it is to the State, and not to the counties or the cities, that we naturally turn for their regulation and control. They serve the people of the State as a whole, and are prohibited from bestowing favors on any one community. There is little or nothing localized about them, nor are they benefited by the activities of the local government, save, possibly, in so far as their local franchises are concerned, in the same peculiar and direct manner as is private individual real estate.

There is, thus, ample theoretical ground for making a separation as to the sources of State taxation from those of local taxation. The general classes of corporations which we have had under consideration are so broad in their activities, their stockholders, and the oft-forgotten consumers of their products, or of their services, are so widely scattered, that it is clearly illogical to tax them, where, by some accident of organization or of legal enactment, their head office may be or their property may lie.

The practical reasons for the separation of State from local taxation are:

1. Complete separation will abolish at once the expense, friction, and annoyance of the vain attempt to equalize between the different counties. Partial separation will lessen this evil, because as the proportion of State taxes to the total tax burden on each citizen is reduced the inducement to undervaluation is reduced in like proportion.

A large part of the inequalities in the assessment have their origin in the attempt of assessors to save part of the State burden to their counties by undervaluation.

The State assessment roll in California is, as a consequence of the prevailing tendency to undervaluation, practically at a standstill.

From 1850 to 1860 the assessed valuation increased from $57,000,000 to $148,000,000, or at the rate of 16 per cent per annum.

From 1860 to 1870 the increase was at the rate of 8.7 per cent per annum.

In 1872 the codes were adopted and the State Board of Equalization established. Such was the activity of this board and the efficiency of the new law that the assessment increased by 130 per cent in two years, from 1870 to 1872.

From 1872 to 1880 the increase was only at the rate of 1.3 per cent per annum.

From 1880 to 1890 the rate of increase was 6½ per cent per annum.

From 1890 to 1900 only 1.1 per cent per annum.

From 1900 to 1902 the roll increased 3 per cent each year.

In 1903, after great efforts by the State Board of Equalization and slashing increases in many counties, the roll reached nearly $1,600,000,000. It dropped back about $50,000,000 the next year, and this (1905) year has gone to $1,625,000,000, a gain of 1½ per cent in two years, or an average of three fourths of one per cent per annum for the two years.

No one will assume that this represents the true increase in the wealth of the State in the past two years.

2. When separation is permitted it is possible to place each tax in the hands of that branch of the government which is best adapted to administer it. The taxation of public-service corporations, for example, whose business pervades the whole State, can not be adequately handled by the local assessors. In every case, in order to obtain any sort of equality, uniformity, and justice in the treatment of these great corporations, it is necessary to call in the assistance of a State board, even if the resulting taxes are distributed among the localities. This is one of the several points at which the general property tax breaks down, and in which our present administrative organization in California is especially weak. If we have separation the State alone would deal with these corporations. This would save a great amount of friction and expense.

The different classes of corporations can not all be successfully taxed by one and the same method. That has been partly recognized in California already in the taxes imposed on the premiums of insurance companies. The local assessors and other administrative officers, engaged, as they necessarily will be, largely in the administration of the local taxes, ought not to be entrusted with the administration of several other sorts of taxes. What is needed is separate machinery for the administration of each of the different taxes.

3. The different taxing districts could each have practical "home rule" in matters relating to taxation. There would no longer be any object in underassessment if there were no State tax on the things assessed by the county assessors. If for any reason one county preferred to have a high rate of assessment and a low tax rate it could do so without assuming more than its fair share of the State burden. If another county preferred to have a low assessment and a high tax rate it could do so without evading any portion of its obligations to the State. If for any reason a county preferred to have its assessment roll revised once in several years only, it could do so without damage to any other community and with a considerable saving in expense to itself.

If each branch of the government collecting taxes did so independently of the others there could be no clashing of interests, and the administration would be much simpler and more economical.

To secure uniformity in the distribution of the burden and equality between different classes when taxes are levied by different authorities is the function of the general revenue law of the State.

This proposed separation of State sources of revenue from those of municipalities and counties is no new thing. Pennsylvania has not taxed, for State purposes, its real estate for many years. Neither does New York. And Connecticut, Ohio, Minnesota, and other states have more or less complete separation.

If this proposed scheme of the Revenue and Taxation Commission should meet with legislative approval (and it will if the people of the State so desire), the owners of real estate, who now pay the greater part of State taxes, will be relieved of nearly $4,000,000 of taxes annually, which means a saving of at least 21 cents on each $100 of our present assessed valuations.

In the following table is shown how much the tax rate in each county will be decreased and what proportion of the total assessed valuation of the county will be taken away by giving the State the taxes on certain corporate property and leaving to the cities and counties the assessment and taxation of real and personal property:

	Saving in the County Tax Rate, in Cents per $100 of Assessed Valuation.	Percentage of Assessed Valuation of Public-Service Corporations and Banks to the Total Assessed Valuation.
Alameda	20.58	11.86
Alpine	49.00	0.00
Amador	34.63	8.46
Butte	27.90	10.54
Calaveras	35.50	5.76
Colusa	40.91	5.85
Contra Costa	34.75	11.31
Del Norte	47.73	0.79
El Dorado	16.86	13.85
Fresno	31.46	11.12
Glenn	36.18	7.96
Humboldt	40.94	5.60
Inyo	35.22	7.00
Kern	16.21	2.06
Kings	31.14	10.44
Lake	46.71	1.05
Lassen	41.23	4.45
Los Angeles	29.76	10.61
Madera	7.986	17.68
Marin	34.61	9.57
Mariposa	16.83	13.68
Mendocino	38.32	6.46
Merced	23.83	14.69
Modoc	47.12	1.74
Mono	34.15	7.78
Monterey	27.16	13.25
Napa	39.16	6.91
Nevada	10.13	14.96
Orange	31.46	11.16
Placer	14.86 loss.	26.94
Plumas	44.69	2.77
Riverside	10.82	19.04
Sacramento	22.37	9.80
San Benito	39.41	5.62
San Bernardino	46.13 loss.	36.94
San Diego	16.81	14.00
San Francisco	34.60	10.99
San Joaquin	29.89	11.50
San Luis Obispo	30.72	10.63
San Mateo	41.50	4.08
Santa Barbara	28.52	11.88
Santa Clara	41.67	4.80
Santa Cruz	27.97	8.60
Shasta	13.76	18.91
Sierra	26.50	7.63
Siskiyou	2.356	28.47
Solano	37.59	7.54
Sonoma	36.20	9.14
Stanislaus	24.15	13.66
Sutter	36.93	10.15
Tehama	30.67	11.87
Trinity	45.37	16.93
Tulare	21.30	17.56
Tuolumne	33.50	8.07
Ventura	0.7 loss.	17.56
Yolo	37.02	9.19
Yuba	20.54 loss.	18.21

It will be seen that all but four counties make a gain by the proposed change of system. This gain is from 8 cents in Madera County to 49 cents in Alpine, which latter has no public-service corporations, and hence saves the entire State tax.

The counties which lose are Placer, Ventura, San Bernardino, and Yuba. The long stretches of railroads in these counties account for their loss. The question of the justice of the loss is discussed in the report of the commission.

The property of the corporations of this State is taxed on the basis of its cost value, while our real estate is taxed, without any reference to its cost, on its real value, which is always determined by what it will produce in rents or products. An acre of land is an acre of land, whether it lies in the driest part of the Mojave Desert or at the corner of Kearny and Market streets in San Francisco. Yet the value, for taxation or any other purpose, of the San Francisco acre is very much more than the desert acre, and for no other reason but because more can be gotten out of it. A mile of telephone wire is taxed about the same whether it is on the desert or in San Francisco. Yet the San Francisco mile of wire, like the San Francisco acre, is worth more, for taxation or any other purpose, than the mile of wire in the desert. A Pullman car, in the hands of the Pullman Company, brings in a very large income on its original cost of considerably less than $15,000. Yet the Pullman cars in this State are assessed on the first Monday in March of each year on the basis of what they cost the company to build them, not, as in the case of your real estate, on their true value, which is, and in the case of the Pullman cars ought to be, determined by its revenue-producing power.

A railroad is assessed and taxed in this State on the basis of its cost. Locomotives, cars, rails, and nearly all the things that go to make up a railway property, cost about the same, whether they are used between Oakland and Sacramento or between Gloster and Lancaster on the Mojave Desert. Yet, locomotive for locomotive, car for car, rail for rail, the Oakland-Sacramento stretch of road brings in a much greater income than do those used on the desert. Nevertheless, all locomotives, cars, and rails are assessed and taxed in California with regard to what they cost, not with any regard to what is their true value, which is based upon the income they produce. Were real estate taxed in the same way as railroads are, many a man in San Francisco, who paid tens of dollars for land that is worth thousands now, would be paying taxes on the small sum that it originally cost him; and many another man would be called upon to pay taxes on the thousands of dollars which he paid for land that is now worth but hundreds.

The same argument applies to the property of every other corporation in this State; its value, for purposes of taxation, as it is for every other purpose, ought to be determined by its power to produce income, just as the value of real estate for taxation and all other purposes is determined. If anybody buys a piece of real estate, except under extraordinary circumstances, he pays such a price for it as he thinks the revenues he can derive from it will justify. And this price determines the basis of its valuation for assessment and taxation purposes. If one buys a railroad, a telephone system, an electric light plant, a bank, a water company, a telegraph company, he pays, not what the physical property cost or, as junk, is worth, but he pays such a price as the income from it will, in his judgment, warrant him in paying. The buyer of a piece of land cares nothing what it cost the man from whom he bought it; neither does he who buys out a corporation.

Real estate is taxed, as the commission has shown, at something over one per cent of its income. We have also found that a little over one per cent of the true value of the farms of this State is paid out in taxes —and this without any regard to whether or not the individual owner of any property is making any money out of it. Making money or losing it, the farmer is taxed one per cent of the true value of his property, which is determined by what it brings, or ought to bring, him in.

If real estate is thus taxed, why should not the corporations be taxed, not upon the cost or junk value of their property, but upon its true value, determined, as in the case of real estate, by its revenue-producing capacity? The commission has formulated a rule by which the true value of the property of the corporations may be determined for taxation, as it is for other purposes. And that rule calls for the taxation of the corporation at such a percentage of its gross earnings as will, as is the case with real estate, equal a tax of one per cent on the true value of its property, which, as in the case of real estate again, is determined by its income-producing power.

To illustrate: If money is worth 10 per cent, any piece of property that will produce $1,000 per annum is worth, all other things being neglected, $10,000, and is taxed with regard to that, its true value. A mile of telephone wire is taxed only on a value of $100, or less, what the wire and instruments cost or are worth as junk, even though its income should be $1,000 per annum, and the true value of the property is, therefore, other things being equal, the same as that of the piece of real property which produces $1,000 per year.

The commission thinks that what is assessment and taxation sauce for the individual tax-paying goose ought to be assessment and taxation sauce for the corporation tax-paying gander. And it hopes that you and the people of this State will see the matter as it sees it.

I have no doubt in the world that there will be some opposition to this scheme which is intended to make everybody, individual and corporation, bear his just proportion of the burdens of taxation for State purposes. One of the grounds of attack will probably be the commission's proposal that the franchises of all corporations, except such as are otherwise taxed by the State, shall be taxed by the State. The commission argues that when the State permits individuals to form themselves into corporations it gives those individuals valuable privileges, for which valuable privileges those enjoying them should pay a return to the State in the form of annual taxes. That the privilege to incorporate and do business is a more valuable privilege than the right to do business as individuals, co-partnerships, or associations, is proven by the fact that all large enterprises are conducted by corporations. Being a thing of value, then why should not those who avail themselves of the privilege to do business as a corporation pay taxes on that valuable thing, just as the owner of anything else of value is compelled to pay taxes on it? And to whom else shall this tax be paid but to the State, which confers the privilege?

Viewed from another standpoint, the privilege to incorporate and do business is the property of the State, which confers that privilege upon individuals in such manner as it may see fit. In California the State lends, so to speak, the corporation privilege for periods specified in the law. Is there any reason why those who borrow from the State the privilege to incorporate should not pay rent, interest, taxes, if you please, for its use, exactly as the private renter, borrower or user of any valuable property owned by another pays rent, interest or taxes for the privilege of using it?

In addition, therefore, to a tax upon the true value of its property, a like tax being paid by every individual property owner, the commission is of the opinion that all corporations not otherwise exempted should, in addition to the tax on its property, pay the State an annual rent, or tax, upon the valuable privilege to do business as a corporation, which privilege is the property of the State and confers benefits of which individuals, as individuals, can not avail themselves.

The State also imposes a poll tax upon males between the ages of twenty-one and sixty years, which yields something like $450,000 per annum and is used for the support of the public schools. If the individual, in addition to the tax upon his property, is called upon to pay a poll tax, why should not the corporations also pay an annual poll tax into the coffers of the State? The commission thinks they should. And it thinks that this tax should be a certain small percentage, say one twentieth of one per cent, on its capitalization. It seems to the commission that any corporation can well afford to pay this small poll tax.

In addition to his property tax and his poll tax, every individual who desires to record the deed to his property must pay the county recorder for the privilege. California requires that any corporation which takes advantage of the privilege allowed it by the State to do business as such corporation shall pay into the State treasury a certain sum, varying with the amount of its capitalization, when it files its articles of incorporation with the Secretary of State. The fees paid the county recorder vary with the size of the document presented for record; the fee for filing articles of incorporation varies with the amount of the capitalization of the corporation. The commission sees no reason why these fees should not be continued.

It may be contended that all these taxes should not be piled, one after the other, upon the corporations. Why not? You pay a general county tax, a road tax, a school district tax, probably a bond tax, State taxes for various purposes, and, if you live in an incorporated town, you pay various and sundry other taxes for schools, police, streets, lights, fire departments, etc., etc. Roads, streets, schools, police, lights, fire departments and all the other things for which you pay taxes go to make the business of the corporations more profitable. Why, therefore, ought they not to pay, as you do, their due shares of the cost of maintaining them? Or, what amounts to the same thing, why should you not be relieved from your State taxes, which, without injury to them, the corporations can, with justice, be called upon to pay? The commission is of the opinion that you should be, and hopes that you will agree with it.

As I have shown above, your real property is taxed on its true value, which has nothing to do with what it cost you, but is dependent upon what it will, or ought to, produce. The property of the corporations, however, except their real properties, is taxed, not on its true value, (which is determined, as in the case of real estate, by what revenue it will produce), but on its cost, or junk, price. Is it not time that the same taxation rules should be applied to all property, private and corporate, in this State? If so, the plan proposed by the Revenue and Taxation Commission ought to be adopted; for that plan will bring about that result.

Finally, let me say that the State Board of Equalization, and the County Assessors' Convention, the members of which two bodies have more practical experience than any one else with our revenue and taxation laws, have examined into and heartily approve the commission's plan. And no one who has studied it has been able to pick any flaws with the principles of the plan or to find any real objections to its theory or its practice.

If it suits the members of this Convention, and I hope it will, the commission would be very glad to have you say so.

MR. JOHN MARKLEY. I would like the permission of asking the Governor a question.

GOVERNOR PARDEE. Certainly, Mr. Markley, with the greatest of pleasure.

MR. MARKLEY. Has the commission investigated the matter to the extent that they have satisfied themselves that the State of California can tax the foreign franchises?

GOVERNOR PARDEE. Yes, sir; for that portion of it which is used in the State of California.

MR. MARKLEY. When the railroad was assessed in 1884, it was claimed that the value of the Federal franchise was mingled with the value of the State franchise. The Supreme Court of the United States, if I am not mistaken, held that the State of California had no power to tax a Federal franchise.

GOVERNOR PARDEE. But, if you will remember, in that famous decision in which they whipped the devil around the stump, the Supreme Court of the United States said that while you could not tax the franchise, you could tax the gross income, or that proportion of the gross income which would be within the State, at such a figure as would tax the franchise; and that the commission proposes to do.

MR. MARKLEY. Then you tax the franchise of the California companies?

GOVERNOR PARDEE. By taxing the gross income of it.

MR. MARKLEY. You would not levy a direct tax on the franchise?

GOVERNOR PARDEE. No, not as such. That is the way we talked about it; but the Supreme Court decided as I have said. It is called colloquially "the decision that whipped the devil around the stump."

MR. MARKLEY. You spoke of the tax on the franchise.

GOVERNOR PARDEE. That was particularly referring to California franchises; but the others can be reached in the other way around.

MR. DIXON PHILLIPS. Can I ask you a question, Governor?

GOVERNOR PARDEE. With the greatest of pleasure.

MR. PHILLIPS. I think it ought to be explained to these people what the purport of that decision was wherein it was ruled that the national banks could not be taxed. I think the general statement made in the report might lead some to an erroneous conclusion of what that decision was.

GOVERNOR PARDEE. Have you the decision on the end of your tongue?

MR. PHILLIPS. I have not, but I do have something of a general idea of what that decision was.

GOVERNOR PARDEE. Would you kindly state it, being a lawyer?

MR. PHILLIPS. It was with reference to deposits in the banks, also its bonds and the certificates that were used, based upon the bonds that they hold that are deposited with the United States Treasurer. I don't think I can give you a clear idea of just what the decision was, but I do not think that that decision goes to the effect that if you had in one of these national banks $100,000 on deposit on the first Monday in March, but what that $100,000 is taxable property.

GOVERNOR PARDEE. That is your property and not the bank's, however.

MR. PHILLIPS. Certainly; but some years ago, Governor, there was a member of the Legislature of this State who introduced, for the purpose of remedying that "escape" from taxation, a bill providing that the banks should give in a statement to the assessor based upon the report that was given either the State bank or National bank examiner. And since that time that member of the Legislature is still "going some." They have never heard from him since. And it has been held by a great many people who have thought upon that question that that is one of the solutions of the great evil of inequality of taxation arising from the assessment. It is simple, because of the sworn statement given to your bank commissioners or the national bank examiners. It prevents them from so juggling the figures that we can not reach them.

GOVERNOR PARDEE. They send money out of the State, and I don't blame them. We ran up against that kind of proposition you spoke of in regard to the $100,000. The $100,000 goes into the bank and is henceforth out of your possession. Somebody else borrows it. There is $300,000 represented by $100,000. If you taxed it all it would be triple taxation, which would be a bad thing for the farmer and a bad thing for everybody. That famous decision of the Supreme Court of the United States that whipped the devil around the stump went to the effect that the law of California, which taxes national banks and their shares of stock, was not exactly of the same wording and to the same effect as the tax law upon other banks in the State of California; and, therefore, the court said you can not tax national banks at all, because you don't tax them as you tax other moneyed property, to use the word of the law. And to-day the national banks are escaping all taxation in this State, except upon their real property, of which they have very little. Now, if there are any national bankers here I do not think that even they would claim that that is a fair thing. Of course, I do not blame them for one moment for taking advantage of it while the law is in that condition.

MR. PHILLIPS. The commission points out clearly the general decrease in the assessed valuation of personal property. Now, will not that proposed system—if I remember, it is something like two years ago that a constitutional amendment provided for the exemption of $100 worth of personal property. Would that not materially reduce the assessed valuation of personal property?

GOVERNOR PARDEE. The first in 1903, I remember very well.

MR. PHILLIPS. Then, as I remember it, there was something upon the question of growing fruits and vines.

GOVERNOR PARDEE. Growing trees.

MR. PHILLIPS. Yes; that is to say, if they were only three years old.

GOVERNOR PARDEE. Yes; up to the age of three years.

MR. PHILLIPS. It provided for their exemption. They applied that on the theory which came from the common law, that it is personal property; but it is personal property incapable of manual delivery, and still it should not be regarded as fixed to the ground—that it should not be regarded as part of the realty for the purpose of valuation; and under the general provision of the Constitution it says the improvements and the land itself must be separately assessed. On that theory those who oppose your system would argue against your statistics and would say that that, to a large extent, is responsible for the reduced valuation of personal property.

GOVERNOR PARDEE. But when we look back forty-five years and remember that the assessed value of personal property and that of realty in this State at that time were equal, and when we remember the great increase of personal wealth in this State since those days, when we remember the great influx of people who have nothing but personal property to bring with them—millionaires, perhaps—and note that the personal property in this State is to-day only fifteen per cent of the total valuation of the real and personal property in the State, I don't think, Mr. Phillips, that even those who would oppose the scheme on that ground would stand more than a minute on their feet when they stop to think about it. We have done a great many foolish things in exemption. I don't think there is anybody who appreciates more than I do the value of churches, but we have exempted church property. We have exempted Stanford University property. We have exempted growing crops. We have exempted three-year-old trees. We have exempted $100 worth of personal property. How can the assessor get away from that? I will tell you. If a fellow is going to take advantage of that and put in his $100 worth of personal property, the assessor assessed it for just that much more than it is worth. We have been talking of these things and have been trying to find a remedy, but still the assessors, poor fellows, haven't been able to find the personal property. Take San Francisco and Oakland alone. The value of the stocks of goods in the stores and warehouses of those two cities is not assessed at one one-hundredth of their true value. Of solvent money and solvent credits in this State, the assessors only find $77,000,000, and thirty years ago they found $122,000,000 worth. Now, nobody imagines for a moment that there is only $77,000,000 worth of solvent credits and money in this State at this time, or that there was only $122,000,000 of that property in this State thirty-five years ago. I am free to say that I don't believe at all that you are going to get anywhere if you try to assess money and solvent credits, but the law says you must.

MR. JUDD. I move, to get this important subject before this Convention, that a committee of three be appointed to make a report. It is of such vital importance that it should be properly gotten before the public. I make a motion to that effect.

Motion seconded and carried.

PRESIDENT COOPER. Before we take a recess, I will state that we invited the Governor-elect to be present at this Convention. The Secretary will read his reply.

EUREKA, CAL., November 23, 1906.

To ELLWOOD COOPER, ESQ., *Santa Barbara, Cal.*

DEAR SIR: Your letter of November 16th at hand. I would be pleased to meet with the Fruit-Growers' Convention on the 4th and 7th of December next, but it will be impossible for me to do so, because I am now trying to arrange my business matters here in Humboldt County before taking my departure for Sacramento. However, I shall be ready at any time to extend any assistance I can to advance the interests of the fruit-growers of the State.

Yours truly,

J. N. GILLETT.

MR. R. D. STEPHENS. I move that we give a vote of thanks to the Governor for his able address.

Motion seconded, and carried by a rising vote.

(At this time an adjournment was taken until 1:30 o'clock this afternoon.)

AFTERNOON SESSION—FIRST DAY.

TUESDAY, December 4, 1906.

The President appointed the following committees:

On Governor's Address—John Tuohy, John Markley, Andrea Sbarboro.

On Chairman's Address—Prof. D. T. Fowler, C. B. Messenger, Dr. W. M. Sherman.

On Resolutions—Judge W. H. Aiken, A. N. Judd, Leonard Coates.

PRESIDENT COOPER. I will state that it is the usual custom in these Conventions that all resolutions be referred to a committee for their place in the discussion of the Convention.

The first paper on the program this afternoon is "Table Grapes," by Mrs. Minna E. Sherman.

TABLE GRAPES.

BY MRS. MINNA E. SHERMAN, OF FRESNO.

The poetry of the vineyard is found in its symbolism. Think of the clinging tendrils reaching out appealingly to seize a support, grasping it, at first softly as a baby's fingers, then maturing to hold the heavy vine with the grasp of a man. The grapes ripen; the wine press is ready, for the vintage has come. The world laughs, for it is again young; once more is the joyous rule of Pan, for the grape has given up its liquid sunshine—the years roll back to the days of Greece. Yet, further on comes the symbolism of the Bible, with the beauty of the vineyard, the strength and then the sorrow of the wine press, and again the enduring strength of the perfect wine.

These thoughts are rather for the eventide, when the lamp is lighted and the closely drawn blinds shut out the day's work. It is now daylight—noontide—and let us away to the vineyard. The day is for work and the night-time for dreams. First comes the land. To some is given the opportunity to select the ground for their vineyards; to others, myself included, the land is already owned, yet it becomes necessary to study the best trees and vines for its capacity. In selecting land for a vineyard—in an irrigated country—it should be level enough for the water to flow readily along the furrows. If it is not level, make it at least level enough so that, by a reasonable amount of labor, the water can be used. The first and second years' growth of the young vines is greatly increased if they are irrigated in June.

The land should be deeply plowed both ways, and well harrowed before planting. Use every care to have the rows straight, and set a short whitewashed stake at each vine. The horses will then see these stakes and avoid stepping on the vines when the land is being cultivated. These stakes are usually made by cutting a bundle of three- or four-foot plastering lath into three pieces.

The newer vineyards are planted with the rows considerably wider apart than the older ones. It is a wise economy, for heavier tools can be used, with more horses and less men—wages are not only high, but careful men are few.

Subsoiling is to be recommended for quick and permanent results.

The vines planted in the wider rows after the fourth year are found to fully occupy the soil, and the tonnage of fruit is not lessened. It has been a matter of common observation that if the crop on the vines along the avenues were used to estimate the amount of grapes in the vineyard, the estimate was always too high, the increased space making the vines along the avenues more productive. The distance the roots extend can be observed by digging in the center of a sixteen-foot avenue; the roots will be found extending from both sides and meeting.

The harrow should be freely used; it needs to follow the plows to break up any clods and to smooth the soil. The moisture from the rainfall is too valuable to be lost, for the water from ditches carries into the vineyards Bermuda roots and Johnson-grass seeds.

Humus, not irrigation, is the need of our soils. The earlier grape-growers filled the soil with water, to its detriment. We to-day can do better by filling the soil with humus, to conserve the rainfall; and then have the cultivation of a dust mulch perfect during the dry season. If there had been less water in the ditches, we would have better vineyards around Fresno, for the alkali would not have been raised to the surface by excessive irrigation.

Humus is added most readily to the soil by growing cover crops and plowing them under. As a summer growth can not be maintained to advantage in a vineyard, the fall sowing of bur clover is resorted to, it being a self-seeding plant that has already the proper bacteria in the soil. Before resorting to cover crops humus is added to the soil by the use of barnyard manure. The vineyard is trenched between the wide way of the vines. After plowing back and forward in the same furrow, the "V" is put in; a ditch 24 to 30 inches deep is made, and manure is filled in nearly to the top. The earth is then thrown back by the "V," and the revolving harrow makes the land smooth once more. This trenching should be done early in the season, and if repeated every fourth year will keep the land open and porous.

The root pruning which the vines receive by the deep furrow method of plowing causes them to form new root ends down deep in the soil. Many vineyards suffer from drying out in the summer time, because their roots lie at the surface. When the vineyard is four years old force the roots downward by cutting off the surface ones. Set a sharp plow down to five inches and run close to one side of the vines. The next season do the same on the other side. Until the fourth year it is not well to do this pruning, as the vines are not firmly anchored in the soil and their foothold may be disturbed too much.

The roots of a vine absorb at the tips, where the root hairs are found; the rest of the root becomes like the stem or trunk, a mass of cells, through which the food is passed out to the growing portion. Cutting off the ends of the roots causes new growth and more root hairs—the same as taking off the tops of an old orchard tree renews its growth. Now, while the roots must be down deep—where it is cool and moist—they need air. The difference in a soil that contains humus is that it lies lightly and holds air. Without abundant humus the dust mulch can not be formed. To form it at all, the cultivation must be deep and thorough. The cultivators must be strong tools; those used in most of the vineyards never reach more than three inches in depth, because they are too flimsy to stand more power in front of them. Money is lost by running them to cut weeds, for that is about all they do. We saw Mr. Teague using at Lemoneera a cultivator heavy enough to go down ten inches and strong enough to stand the draught of four mules. It is a riding tool, one that has been modified and strengthened from an Eastern pattern (by Mr. Teague) to meet the needs of his lemon orchard. We purchased two, and the marked improvement in the work this cultivator does, over the smaller and lighter cultivator, is shown in my young vineyard, which to-day is nearly as large at two years as other vineyards are at four years old.

About October first, before any rain had fallen, the dust mulch was perfect up to the surface; the moisture was nearly to the top, and the earth was friable down seven inches. This big cultivator ran only one way of the vineyards; this left a core that was cross-cultivated by the ordinary vineyard cultivators. The soil in this core was hard and dry at three inches from the surface.

The commercial fertilizers, bone meal and Thomas slag, are put into the plow furrow at the first plowing. In the spring the nitrates are put into the ground after the growth starts. One year commercial fertilizers are used; two years barnyard manure is broadcast, and the fourth year the vineyard is trenched and manure put in deeply. In a healthy vineyard this will keep up the vines to a maximum production, and balance the leaf growth with the fruit products.

The use of sulphur to control mildew is universal in all vineyards; it is applied when the vines are just beginning to break bud, again when the foliage is out six inches, and sometimes the third time if mildew shows at all. The sulphur acts through the fumes given off by the sun heat. If it is cold and dark weather the mildew travels fast, while the sulphur does not volatilize.

In growing red grapes, like the Emperor, sulphur can not be used late in the season without marring the beauty of the fruit; wherever it strikes a berry it makes a light spot that is a blemish. The Emperor grape matures late in the season, and may have several showers fall on it before the temperature is low enough to prevent mildew. We have used Bordeaux mixture for this. I advise this practice with due caution, for the University professors do not indorse it. They think it useless to control mildew. I gave in once and had four carloads of mildewed grapes to cull out for the winery. The sulphuring was attended to regularly and plenty of it used. Last year the Bordeaux mixture was carelessly made; it could not be seen on the vines; as a result we had to buy extra sulphur at $70 a ton in Los Angeles after the San Francisco disaster. The vines mildewed and many grapes were culled in the packing-house this year. Some years we never use any sulphur for the vines at all. No mildew showing, we do not hesitate to let the Bordeaux mixture have the credit, for when the vines are showing mildew on the next vineyard the conditions are certainly favorable for it. The new French sulphuring machine will be here in time for next season's use, and we hope it will overcome the objection the white men have to using sulphur.

The varieties commonly shipped to the East are the Thompson Seedless, Sultana, Malaga, Muscat, Tokay, Cornichon, and Emperor. In less than carloads are the Rose of Peru, Black Prince, Verdal, Colmar, Black Muscat, and a few others. The Thompson Seedless and Sultana are raisin grapes, but since the seeding of the Muscats has become a commercial success, the demand has lessened for them, and the amount shipped green has largely increased. When planted on sandy loam the fruit ripens early; both varieties are light green in color, shading to amber; the bunches are large. While the shipping of these varieties pays well, they have never commanded the fancy prices paid for Malagas, Tokays, or Emperors. The pink form of the Sultana, sent out by the Government as Sultana Rosea, has not as yet proven a heavy enough cropper to be largely planted; it is a beautiful grape, but has as yet to make its way to market.

In a good vineyard the culls should be light. The entire crop should be sent through the packing-house, when it is on the ranch; then the culls can be weighed and some definite idea arrived at as to what is being done. If the culls exceed more than ten per cent, the grower should watch the pickers and packers closely. If the fault is not found there, then the attention must be turned toward the vineyard.

The pedigree of a vine is as important as the pedigree of an animal. The Emperor grape has been a favorite of ours for many years. When the culls were very heavy one year, the thought came (probably suggested by the success in grading up a dairy herd) that the vines needed culling. I started in the next season two weeks before picking time and marked every vine that had merchantable fruit—fruit of high color, size, and large bunches—with a stroke of white paint on the trunk of the vine. The next season I repeated the work, using red paint. The vines having the two colors were used to furnish nursery stock for a new vineyard. When the roots were set out only the strongest were used. The result was an increased tonnage, with a large per cent of fine fruit and the culls less than a quarter. The marking of the vines in the second vineyard was again repeated for the cuttings for a third vineyard, and when this vineyard came into bearing three acres produced as much as four of the original vineyard.

The nurseryman never seems to think that a vine is an individual, but takes the buds or cuttings from any tree or vine, so long as it is true to name. The weakest is mixed with the strongest, until the average production is reduced greatly. Many varieties of fine strawberries have been run out by this lack of care. While the careful going-over of the vineyard as described cost nearly a month of hard labor, the first year's increased production paid for it handsomely. The dairymen, who are classed as ignorant, are fully aware of the necessity of making every cow do her duty. It is now time the learned fruit-grower follows the dairyman's wise example.

The packing of Tokays and Emperors calls for greater skill than the packing of green grapes like the Malaga. The red grape packages must have even coloring and the bloom must be preserved. The bloom is injured by careless picking and hauling in the small forty- or fifty-pound picking boxes. The large raisin sweat-box, with four inches of clean hay in the bottom, and covered with a heavy sheet of paper, makes a good carrier from the vineyard to the packing-house.

The pickers cut the bunches and hold them by the stems, never touching the berries. They lay them, with the stems up, carefully along in the sweat-boxes, one layer only. The wagons have springs under them, and the teamsters are warned to drive slowly. Two men lift these boxes and carry them from the wagon into the packing-house, stacking them across each other, log-cabin style, to leave an air space between them. After twenty-four hours the grapes are ready for the packing tables, as the stems are softened enough not to snap. The large boxes are then sent into the packing-house and a woman stands ready to pick the clusters out of the boxes before they go to the ordinary packers' tables.

Constant watchfulness is necessary to keep the ordinary packers from putting poor fruit into the crates. They seem to think they are doing you a favor by making as many crates as possible out of a given amount of fruit. They can not understand that it is expensive business to ship poor fruit East. The poor fruit is worth something in the pig pen, but is worth nothing with a crate and refrigerator charges added when sent off in a car. Over and over, until I think they must have it driven into their brains, I say, "If you are not certain it is good, put it in the cull box, for it is better to be sure than sorry."

A man who is often overlooked is the car-loader. As he wheels the fruit into the car he can give it some ugly jolts. Every box of grapes that fails to keep is bruised by rough handling, often by the nailing down of covers on fruit that is packed too high. Eggs are really tougher than grapes. We do not consider them so because they make a troublesome mess when broken. The grapes make their troublesome mess later and show up in bad shape to the Eastern buyers. The railroad's handling of the refrigerator cars is much rougher than it used to be. The heavier engines and longer trains bump them around to such an extent that even with the heavy export shook we use on our grapes, nearly every car shows one or more broken crates.

When I first began to pack grapes, the bunches were clipped and fitted into little baskets and put into a double crate holding eight. We refused to have the double crates after the first season; the second season we refused to cut up the big bunches to fit the small baskets. I took the baskets and cut down a side of each, laid it across the bottom of the other basket, and fastened it there with a double-pointed tack. This made two baskets to a crate. They sold for surprisingly high prices. The next season the baskets were purchased in Chicago in advance. One morning I came over from the packing-house and hunted up pieces of baby ribbon around the house. I then decorated ten crates and sent them to Eastern friends. One crate was put into the car for the auctioneer who had encouraged the packing of the clusters. When the car reached New York a telegram came, "Put ribbons on all the clusters." Only one car was left to be packed. The Fresno stores never before had such a run on baby ribbon. That car then sold for the highest price ever received for a car of grapes at that time, over $1,900. Since then we have sold for over $2,000 a car, and one year a car sold at the rate of $3,000 for the grapes; unfortunately it had other fruit in it.

We have had years when three fourths of the crop was clusters. One car had only fifteen crates that were not clusters. At times we have used a half crate for the finest clusters, and marked them "Imperial." In this package there are never more than two bunches, and these must be perfect in color, with large berries. These are decorated with twenty or thirty yards of baby ribbon of a becoming shade.

Bunch packing is again coming into use, for the trade has at last recognized that the faced pack is a very homely package; the grace and beauty of the grape being entirely lost in the mechanical regularity. The name is all that is new in the bunch pack. It is simply the plain cluster as distinguished from the Fancy Cluster and the Imperial Cluster.

Overproduction has been the cry ever since I began to grow grapes. This has been held up at every fruit-growers' meeting. We have found in the shipping of green fruit that it was lack of distribution that kept our fruit from selling. In the early nineties we shipped from the ranch ten cars of Emperors; our previous shipments had never exceeded seven cars. The last car slumped. The auctioneer wrote that the market was absolutely overstocked and the trade could not handle more. He was really troubled for fear we would send in more next year. When the lists were returned the grapes were seen to have been sold to people outside the larger cities. Since then these smaller places have been heavy purchasers of fruit.

The secret of a successful trade is honest packing; but I confess that after the last two years' experience I am not sure that I can ever make the pack I used to with girls at the tables. The packing-house was then a delight; every one vied in doing good work; all was orderly, no strikes, no rough people anywhere to annoy. The "bloom was on the grape" and on the packers. But the women are gone. I suppose they all made money and got married; any way they are scarce. In the old days the joy of the vintage was there; the packers sang at their work; the joy spirit lifted us all above drudgery. The last two seasons—"a plague and curse on them"—the Japanese have been the bulk of our packers. I have yet to see a Japanese packer that could equal a green girl hand, after two days' packing under my instruction.

The real issue to-day, gentlemen, is not growing, selling, or marketing the table grape, but labor—men to work the vineyards and packers that can be trained to do intelligent work. In the San Joaquin Valley to-day the "Jap" is the only packer easily secured; he is a high-priced piece of inefficiency that is neither ornamental nor useful, but must be endured.

PRESIDENT COOPER. There being no objection, the paper you have just heard read will be received and placed on file. The paper is now open for discussion.

DR. E. A. HARE. I have been much pleased with the paper of Mrs. Sherman, and I wish particularly to emphasize one point. I was pleased with what has been said regarding the growing and cultivation of grapes, but I will confine myself to the one point of marketing. The acreage of table grapes is being increased every year very rapidly, but the market for table grapes is not increasing rapidly, for the simple reason that for two years past the grapes have not been as satisfactory as formerly. That is something for us to think about, if we would maintain grape-growing as an industry. I spent three years in Eastern cities, particularly in Washington and New York, and I followed this market very closely. My experience with California fruit was not at all pleasing. I did not want California fruit on my table—at least the grapes that were coming to market, for they were in very poor condition. One of the reasons why we do not get good prices for our grapes is the simple fact that we do not know how to pack and put them on the market. I do not mean that we don't know how to do it; I mean we don't do it. On the tables in the East I saw hundreds of bunches of grapes that were sour, green, and absolutely worthless, not fit to come on any table. I would not put them on my table, nor would anybody else. Yet we ship carload after carload of that kind of fruit. There never was a year when California had the world by the ear as it had this year. The first carload or two of grapes that came through were sour and very bad fruit. The people who bought them said they did not want any more of them, and of course, even though the grapes came through later in good condition, the people would not eat them after their former experience. A man who puts up a good grape, and only a good grape, is the man who will establish a reputation for good fruit that will bring him a good price; but a single car of bad fruit will injure the entire market. I do not think we realize that every one of us who ships a carload of bad fruit injures the entire market for his neighbor and for everybody else.

PRESIDENT COOPER. The next paper on the program is "Wine as a Remedy for the Evil of Intemperance."

WINE AS A REMEDY FOR THE EVIL OF INTEMPERANCE.

By ANDREA SBARBORO, of San Francisco.

Mr. President, Ladies and Gentlemen: I am going to speak to you on the most important question of the day. I am going to show you how we can drive the curse of drunkenness from our midst.

St. Patrick was made a saint for having driven the snakes out of Ireland. It is a pity that at the same time he did not drive the curse of drunkenness from that country, for it is surmised that the people of the Emerald Isle brought the baneful evil of drunkenness to the United States.

The man who will succeed in driving this great evil from our country will be a public benefactor and deserves to be made a saint; more so than even the holy St. Patrick.

Drunkenness is the greatest curse and causes more crimes and misery than any other evil this country is afflicted with. Many attempts have been made to remove the vice from our midst. Benevolent and philanthropic people have joined together and formed temperance societies, and for the past fifty years have wasted millions of dollars and much valuable time in trying to eradicate the evil.

From temperance they have formed prohibition societies and striven hard to prohibit the sale of wine as well as really intoxicating beverages in cities and towns; but, alas! prohibition does not prohibit.

From the very beginning of the world Adam and Eve were placed in that glorious Garden of Eden, and told that they could partake of all the fruits and delicious things before them, but were prohibited from eating the fruit of the apple tree. It was just the apple tree which tempted them most, and of which, to their and our sorrow, they did partake, and since that time we, their children, have inherited the same desire.

Then, what is the remedy for the removal of drunkenness? The cure is a very simple and pleasant one, and all we have to do is to take the example of the people who live in the wine-producing and wine-drinking countries of the world. In France, Italy, and Spain, where every man, woman, and child use in moderation wine with their meals, intoxication is almost unknown. Whilst in countries like Russia, Holland, England, Scotland, Ireland, and our own United States, where wine has not been produced, except in California in recent years, and the people have not as yet become accustomed to the use of it, drunkenness exists to an alarming extent.

The fact that wine is a remedy for the cure of the evil was well known one hundred years ago by that grand President of the United States, Thomas Jefferson, who, when Congress was debating the placing of a high tariff on the importation of wine, said, "Wine is a necessity and not a luxury, and that no nation is drunken where wine is cheap; none sober where the dearness of wine substitutes ardent spirits as its common beverage." The wise words of President Jefferson have been fully verified by sad experience.

WINE SHOULD BE USED IN THE ARMY AND NAVY.

Just before the last presidential election Mr. R. P. Jennings and myself, on behalf of the California Promotion Committee, went to Washington and called on the President and different heads of departments for the purpose of inducing them to introduce in the Army and Navy some of the surplus products of California, which were both healthy and cheap.

On calling upon the Secretary of the Navy, then Mr. Paul Morton, Mr. Jennings recommended the use of raisins and prunes in the navy, and I said: "Mr. Secretary, as California is now a wine-producing State, where wine can be had pure, good, and cheap, why not serve the men of the navy with a ration of wine, as is done by the wine-producing nations of Europe?" The Secretary—whom we found to be a very genial gentleman—smiled at me and touched an electric button. In a few moments appeared before us a tall, thin gentleman, in the full uniform of an admiral. The Secretary said, "Admiral, Mr. Sbarboro here, suggests that we furnish a ration of wine to our marines. What do you think of it?" The Admiral raised his hands in holy horror, and said, "Mr. Secretary, do you wish to make drunkards of our boys?" The words of the Admiral shocked me. I could not see how a man could have arrived at such an elevated position and yet be so deficient in the knowledge of the effect of serving the navy with a small ration of wine at the meal of the marines, and I said, "Admiral, I have been living in the seaport city of San Francisco for the past fifty years. I have seen warships steam into the bay from all countries of the world, and let me tell you, sir, that when there arrives in port from the wine-producing countries a man-of-war which furnishes its officers and sailors with a ration of wine daily, the day after its arrival we see these men walking our streets neat, straight, and sober, like gentlemen, whilst when there arrive war vessels from Russia, England, and—I am sorry to say—from our own United States, the following day we see sailors staggering along the streets of the city, beastly drunk; sometimes even lying in the gutter, disgracing the uniform they wear."

This fact has recently been fully demonstrated in a very forcible manner by no less a person than the Surgeon-General of the United States Army.

It will be remembered that some years ago there was introduced in the United States Army, among the soldiers, the canteen, which was simply a club-room where the soldiers could meet and buy their wine, beer, and light beverages, and the profits derived from the sale of these things by this little club were used by the soldiers themselves in purchasing little dainty edibles which are not furnished by the Government.

Although the canteen worked very satisfactorily, some of the deluded women of the country made an appeal to Congress for its abolishment. They feared that their children would become drunkards, and threatened to call them home unless the canteen was abolished. And sure enough, at the next Congress a law was introduced to abolish the canteen. As president of the Manufacturers and Producers' Association of California, by order of the directors, I wrote a forcible letter to Senator Perkins, representing our State, showing him that the canteen was a benefit to the health and sobriety of the soldiers, and also a benefit to the viticultural industry of California. The Senator answered me that he admitted every word I said was true, but that he had been so pestered by the women of the country that he dared not vote against the bill! And, in fact, the bill passed and the canteen was abolished.

The officers of the army soon discovered that it had been a serious mistake to abolish the canteen, and petitioned Congress to reëstablish the same.

The report of Dr. O'Reilley will show you the consequences of the non-existence of the canteen, which plainly demonstrates the good or evil done by using or not using wine by the people.

I quote from the San Francisco Bulletin of November 12, 1906:

EVIL EFFECTS OF CANTEEN REMOVAL.

America Now Has the Distinction of Having the Drunkest Army in the World, Says Surgeon-General's Report.

WASHINGTON, November 12.—The United States Army is the drunkest in the world, according to figures contained in the report of Surgeon-General O'Reilley, head of the medical department of the Army, which has just been made public. Though General O'Reilley does not so state specifically, this undisputed eminence has been attained since the abolition of the canteen system. Several commanding generals have made this plain. The report also makes it clear that many diseases from which soldiers suffer are caused by driving them outside of the posts for amusements.

DRUNKARDS SHOULD NOT MARRY.

Rev. Frank Crane, author of "The Religion of To-morrow," writes: "We might refuse to allow marriage to those tainted with insanity. According to the sixtieth report of the British Lunacy Commission, 'a quarter of the cases of insanity can be clearly traced to heredity.' Do you know how insanity is increasing in Massachusetts?" [Which, by the by, is one of the strongest prohibition states in the Union.] And he adds: "And we might forbid marriage to the 'habitual criminal,' and to the 'habitual drunkard.' No person twice convicted of drunkenness should be allowed to reproduce his kind."

CURE OF DRUNKENNESS IN FRANCE.

Some fifteen years ago the French Government noticed that insanity was increasing to an alarming extent in that country. A commission of eminent physicians and scientists was appointed to investigate the cause of this evil and report the remedy. The commission, after making a most careful research, reported to the authorities that since the phylloxera had destroyed the grapes in France, the people, not having any wine to drink, had acquired the baneful habit of drinking absinthe, a strong alcoholic beverage something like whisky, which was the cause of the large increase of insanity. They further said that the only remedy for the evil was to extirpate the phylloxera and reproduce the grapes.

For this purpose France spent millions after millions of francs, and finally found a remedy by pulling up all their grapevines and setting out the resistant variety; and further, the government removed all license on the sale of wine, so that the people might again have their healthy beverage, and have it at such a price that it would be within the reach of all. And thus was the evil of insanity in France checked.

The eminent Dr. Lyman Abbott, of New York, in an article published in the "Outlook" of October 22, 1904, concluded his able address by showing the propriety of the American people using wine with their meals, by saying: "Personally I have entire respect for the total abstainer who really does abstain, and also respect for the one who believes that it is legitimate to use wine in moderation upon the dinner-table, but I find it very difficult to maintain respect for the total abstainer who abstains from the dinner-table and then drinks it out of a closet between meals and calls it medicine. About such an one there appears to me rather a serious deficiency, which it is charitable to hope is intellectual rather than moral. Such imbibers are often entirely honest, but they are usually deluded."

EDUCATE YOUNG CHILDREN TO DRINK WINE AT THEIR MEALS.

Again, Dr. Martin Regensburger, President of the California State Board of Health, says: "If the people of this country were educated, from babyhood up, to drink wine, alcoholism would be a rare disease, as has been proven in wine-drinking countries. It is the forbidden fruit that tempts. In my experience, in families where the wine flows freely, drunkards are the exception, whereas many of the offspring of teetotalers and wine-abhorrers who have not tasted alcoholics until they almost have grown to be men, become drunkards. It would be interesting to compare the statistics of drunkards in wine and beer drinking countries with those of England and America."

These statistics have been shown by our Surgeon-General of the Army, R. M. O'Reilley, who reports that, for the fiscal year 1906, out of every 1,000 soldiers 29.65 cases of alcoholism are sent to the hospital for treatment every year. He added: "As compared to other countries, this is a remarkable showing. The British army is next on the list, and it shows 2.1 cases of alcoholism in every 1,000 soldiers. The lowest percentage is that shown by Spain, the figures of which are put at 0.08 in every 1,000 men, or less than one man in ten thousand drunk." If the figures of the armies of Italy and France, the other nations which furnish wine to their men, should have been given, I am sure that they would have been minimum like that of Spain.

To further illustrate the truth of Dr. Regensburger's assertion, I will tell you of an incident which, although somewhat personal, is too realistic for me to omit. Some fifteen years ago I was called upon to speak at a meeting of the Manufacturers and Producers' Association of California, which was held in Santa Cruz, to an audience of four hundred or five hundred people, among whom were many ladies, some ministers and several representatives of the Salvation Army. My subject was for the encouragement of our people to use home products. Incidentally I remarked that the hills surrounding Santa Cruz could produce very fine wine grapes, and that the many acres of land which were now worth $6 per acre as sheep ranges, could be made to pay interest on $100 per acre in producing wine grapes; but, I remarked, it must be remembered that every bunch of grapes makes a glass of wine, and that unless we find consumers for this glass of wine we will not be able to dispose of the grapes. Therefore, I said, we must encourage the industry and commence right here and become educated to the moderate use of the healthy beverage of wine at our meals; and you, ladies, should give it, diluted with water, to your children at an early age.

From some parts of the house I heard disapproval of my last remarks. Then, I said, ladies, I want to tell you of an incident which happened to me twenty years ago at the Wilkins Hotel, right here in Santa Cruz.

I had just arrived with my wife and babe of eighteen months old at the dinner table, where there were over one hundred people. As soon as we sat at the table I ordered, as usual, my bottle of wine, and when it was opened my wife, imitating what her mother had done for herself when she was a baby, poured a little wine and then a little water in the glass and gave the babe to drink. The ladies in the dining-room were shocked! I could hear them murmur, "Oh, poor child! see what cruel parents, to give that little baby wine to drink. Shame! what cruel parents!"

Now, let me tell you, ladies, I said to the meeting, that babe and four others of my children, who are now grown men and women, have been using wine at their meals from the time they stopped nursing, every day of their lives. They don't know what intoxication is, and should they live as long as Methuselah they never will. I hope that you mothers, who have disapproved of my remarks here this evening, can say as much for your children.

ON DRINKING WINE AT STANFORD.

In a very interesting address delivered last June in Napa at a Promotion Committee meeting, the honorable and brilliant Chester H. Rowell of Fresno ended his discourse by saying: "I should not be surprised to see the time come when we send temperance lecturers East, to preach the merit of wine as a temperance drink."

That is the keynote to the situation. You ladies and gentlemen of temperance societies, who have done so much to abolish drunkenness, but without success, now just try the true remedy, and I am sure that you will succeed in removing drunkenness from our midst.

An eminent lady at Stanford University has started the ball a-rolling. A dispatch published in the San Francisco "Chronicle" of November 20, 1906, says:

> STANFORD UNIVERSITY, November 19.—The most interesting article that has ever been written at Stanford on the question of drinking among the collegians, appears in the issue of the *Sequoia*, which is just out. This article was written "by a Stanford woman,' but the writer's identity is concealed under that broad name. The article defends the drinking habit among collegians at Stanford and shows that it really serves to teach a man how to drink and prevents him from ever becoming a common drunkard.

I have heard some people say that whilst wine may be used in Europe without causing intoxication, it is perhaps due to the climate, and that in the United States it has a different effect. To disprove this, I have only to say that at the vineyards of the Italian-Swiss Colony at Asti, this State, where from two hundred to three hundred common laborers are employed daily, several pitchers of wine are furnished on the tables for their meals and the workmen help themselves and drink all that they desire. This colony has been in existence now over twenty-six years, and I assure you that it has never had an intoxicated person on its premises. So evidently wine may be used in any climate. In fact, in California, where much wine is already made and larger quantities are used than in other states, intoxication is much less than in any other State of the Union.

It will probably be interesting for you to know that in Italy there is consumed twenty-five gallons of wine per capita per annum, while in the United States there is used less than one half gallon per capita of wine, but the enormous quantity of one and one half gallons per capita of whisky per annum, or three times as much whisky as wine. In the one country drunkenness is almost unknown, and in the other drunkenness exists to an alarming extent, and our army has been pronounced by the Surgeon-General of the United States the "drunkest in the world."

Now I want to show you, ladies and gentlemen, that by educating the American people to the use of wine at their meals, in addition to the State of California—which is the only State in the Union where the true wine grapes grow to perfection—being the happy means of having driven the evil of intoxication from the United States, the benefit derived by our State will be simply enormous.

France produces one billion and a half gallons of wine per annum, from which it derives over three hundred million dollars. Italy, with a population of thirty-five million people, produces one billion gallons, and derives from it two hundred million dollars per annum.

California is one third larger than the kingdom of Italy. Her soil and climate are almost identical.

CALIFORNIA WINE AWARDED A DIPLOMA OF HONOR AT THE MILANO EXHIBITION.

We now produce just as good a quality of wine in California—if not better—than that produced in either France, Spain, or Italy. This may be seen from the fact that England, Germany, Switzerland, and Belgium, near the wine centers of Europe, are now purchasing California wines, and is further confirmed by the recent award to California wine produced by the Italian-Swiss Colony at Asti, Sonoma County, of a grand diploma of honor by the Milano Exhibition in Italy, our wine coming in competition with the best wines of Europe. When the consumption will require, we can produce in this State as much wine as is produced in either France or Italy.

The population of the United States is now about equal to the population of France and Italy combined, but Prof. Frederic T. Bioletti, of the State University of California, in a splendid address on "Viticulture and Temperance," recently delivered at the Farmers' National Convention, at Rock Island, where he was sent by our esteemed Governor Pardee—who, it must be said to his credit, has always taken a great interest in this growing California industry—to address the farmers of our country on the viticultural industry of California, said that if the United States contained two hundred million inhabitants, the State of California could supply all of them with pure wine at their meals. Therefore, as soon as we will have reached the happy period when our people will have become accustomed to the use of wine at their meals, the viticultural industry of California will give employment to many thousands of people, and then every hillside in almost every county of this great State will be covered with beautiful vineyards and wineries, squeezing rivers of wine from our juicy grapes.

WINE CREATES GENIUS.

I was amused one day in reading a lecture delivered by a minister, who stated that in Italy, where the people soaked themselves, so the minister said, with wine, they were stupid and deprived of intelligence. Well, now, nothing could be farther from the truth. You take any of the encyclopedias showing names of the great men of the world, and you will find more men of genius born in Italy than in any other part of the globe. Commencing with Michael Angelo, Raphael, Dante, Galileo, and many others in the early ages and coming down to Columbus, Donizetti, Verdi, and Marconi of the present time, we find that they were all wine-drinkers. In fact, it is said—and it must be true—that the imbibing of the grape juice creates genius.

HOW TO USE WINE.

Wine should be used at meals not only by the rich, but by everybody. While those who can afford it can purchase their wine by the case and thus obtain wine of well-known brands and with fine bouquet, the mass of the people must obtain good sound wine in bulk by the gallon which will not necessarily cost them more than their tea or coffee. When it is bought by the gallon it should be all bottled immediately, well corked, and the bottles be kept laid down. To make wine cost still less, it may be diluted, at time of using, with half water. All beginners, and especially children, should take their wine only in this way. If the wine-maker could do so, he would gladly save you that trouble; but you must know that if water were mixed with wine before ready for use, the wine would spoil and turn into vinegar.

Wine should only be used at lunch and dinner. This should be either white or red wine, according to taste, but should be dry and not sweet wine. Port, Sherry, Angelica, Madeira, and such sweet wines admit of no water, but being more alcoholic than the dry wines should be used in small dainty glasses with cake or dessert, and in the place of "teas" in the afternoon social gatherings, in small quantities. To show you how little as yet the American people know about the use of wine, I will inform you that in the prohibition State of Maine and the other Eastern States the people consume 95 barrels of sweet wines, which contain 24 per cent alcohol, against 5 barrels of dry table wines, which contain only from 10 to 12 per cent alcohol. The reverse is the case among the educated wine-drinkers.

People who have never drunk wine frequently say, "I don't like it." How do you know that you don't if you do not drink it properly. First just put a little wine in a glass of water when you feel thirsty, and you will see how good it tastes. Increase the quantity of wine and reduce the quantity of water gradually, and you will see how pleasantly you will get used to it, to the benefit of your health.

Hotel and restaurant keepers should encourage the use of wine by having the waiters ask their customers, "What will you have to drink, tea, coffee, or wine?" The price should be reasonable, and not like in some hotels where they charge more for a pint bottle of wine than they do for the meal itself. Those who sell wine, marking their wine list down at a reasonable price, will add to their profits by the large increase of wine that they will sell and satisfy their customers.

Now, in order that we may achieve something tangible from the result of this important meeting of California fruit-growers, and that our State and the Nation may be benefited by our labor, I propose the adoption of the following resolution:

WHEREAS, It has been clearly demonstrated that the State of California can now produce as fine a quality of wine, and, when the demand will justify it, put forth as large a quantity, as the greatest wine-producing countries of the world, and thus be the means of improving many thousands of acres of land which are now unproductive, which could make pleasant homes for thousands of people in the viticultural industry of this State; and,

WHEREAS, It is a well-known fact that in the wine-producing and wine-consuming countries of Europe intoxication is almost unknown, whilst where wine is not produced drunkenness prevails to an alarming extent; and,

WHEREAS, We consider that, for the above reasons, the use of wine should be encouraged in California, separated from the saloons, and be permitted to be sold freely everywhere, as is now sold coffee, tea, or milk; therefore, be it

Resolved, By this California Fruit-Growers' Convention, that we recommend to the next Legislature the passage of such laws as may be necessary in order that wine shall be permitted to be freely distributed to the people in this State, free from the payment of license, and not affected by the prohibition laws of any town, city, or county of California.

PRESIDENT COOPER. Is the resolution you have just read seconded?

The resolution was seconded.

PRESIDENT COOPER. It will be referred to the Committee on Resolutions.

MR. J. W. WEBB. Is it in order to move an amendment to a resolution?

PRESIDENT COOPER. Yes.

MR. WEBB. I know time is short, and I will speak right to the point. I suppose probably I am the only man in the room who is wearing the badge of those deluded women who asked for and obtained the abolishment of the canteen, and in chivalry I feel I must sustain their course. After a few remarks to the members of the Convention I will move an amendment.

Mr. Sbarboro spoke freely, and I am glad he did; but when he says that prohibition does not prohibit, I think we have memories long enough to know that when they prohibited altogether wines, whiskies, and beers in San Francisco, the police were pretty nearly out of a job. (Applause.) And the refugee mothers and sisters and daughters walked the streets without fear. But since they have unloosed some two thousand saloons, I guess gas pipes have gone up to a premium, and murder and rapine and other things have been exceedingly prevalent.

Now, about the canteen; as that was spoken of, I want to say the women were right. They gave, for the freedom of Cuba and for other patriotic causes, their boys, going from Christian homes, from temperance homes. They did not expect that Uncle Sam would put a drinking place, call it saloon or canteen, under the Stars and Stripes, and then induce and tempt and snare their boys into drinking; for the boy who was invited to take a drink of beer at the canteen and said, "No, my mother taught me never to go into a saloon; I fear it would break her heart to be drinking wine or beer here," would be sneered at. "Of course, you won't pay a dime for it, but you will take the profits to put better things on our table." Isn't Uncle Sam able to give our soldiers the proper diet without having our good boys go into the liquor business?

About France. If I am not mistaken the public prints have said that the wine habit was one of her foremost evils. And the President of the Medical Society has himself signed the total abstinence pledge from wine and all intoxicants; and a great number of the physicians of France have done the same, as an example for total abstinence from all intoxicants, including wine.

If I am rightly informed, and I have seen the fac-similes of them in print, the French government has put up large placards at the railway stations warning the people against alcohol. It is not the juice of the grape; it is the deadly alcohol, whether it is wine, or beer, or whisky, that we are afraid of. I would not be afraid to take a vote of the mothers of this town, whether they think it is safe to give their babies and their boys and girls wine in order to save them from drunkenness. Their mother hearts and their fears would rebel against it.

In the island of Australia, where they make good wines, my Christian mother gave me wine, and so did my uncle, who was a judge of the Supreme Court, but I signed the pledge after I had almost gone over to the damning maelstrom of drunkenness.

Now, the amendment I propose, Mr. Chairman, is that this society believes with a celebrated writer of ancient times that we should not look on wine when it is red, when it giveth its color in the cup, when it goes down smoothly, as the Revised Version says, because at the last it bites like a serpent and stings like an adder, and that it is good neither to eat flesh nor to drink wine or anything whereby thy brother stumbles and is made weak. I move that as an amendment.

MR. S. H. TAFT. I second the motion.

After further discussion the Chairman declared the question closed and referred the resolutions to the Committee on Resolutions.

THE FRUIT-GROWER'S AIM.

BY HOWARD C. ROWLEY, OF SACRAMENTO.

It may jar the sensibilities of some to state the facts just as they are; but, aside from a small class, very, very few in number, represented by such shining examples as Luther Burbank, the fruit-grower has but a single aim. This may be set down in the one word--price. Public spirit and curiosity in experimentation at times play a small part, but resolving the matter down to the basis which you all know is at the foundation, the aim of the fruit-grower is to get the best possible price for his product. Of course, he at the same time wants to get an improved quantity and improved quality in production, but this is merely a means to an end in 999 cases out of every 1,000, and has as its ultimate object—more money. It would seem, therefore, that the consideration of means looking toward this end is of prime importance, and in publishing "California Fruit-Grower" it has been my object to specialize as particularly as possible on the commercial side of fruit-growing, not, however, overlooking the matter of improvement in quality and methods of production, which are of vital import to the fruit-grower in the accomplishment of his aim. There are several cardinal points, as I see it, in obtaining the best possible price for your products:

Produce the best possible article for the class and character of trade you intend catering to.

Keep as thoroughly posted on selling conditions in your line as is practicable.

Another point is honesty; honesty with those with whom you are dealing and honesty with yourself. You must turn out an honest product—just what it purports to be—and you must keep strictly to the letter of your obligations in all dealings, and insist on others doing the same, and if they do not, look around for somebody else to deal with. There is a great deal of antagonism and dissatisfaction, not to use any stronger term, existing between the fruit-growers and buyers and packers who handle their product. Both sides are responsible for this, and I believe that a great deal of the hard usage and bad treatment that growers get at the hands of packers and buyers is owing to lack of discrimination and judgment in picking out the people with whom to deal. If you have had good treatment and honest dealings from a packer with whom you have been doing business for perhaps a number of years, and some other fellow comes along that you don't know anything about and offers you a fraction better value for your goods and you sell them to him and get caught one way or another, who is to blame?

It must be remembered, of course, that the grower is not the only individual in the world who is after a living and the best possible price. Every one else connected with the fruit business, or any other, is in the same boat; we are all looking for the highest price when we have anything to sell and the cheapest price when we have anything to buy. It is a natural proposition that a fruit buyer wants to get his stuff at the very lowest price at which he can buy, but this fact should not lead to prejudice. Again, in this matter of honesty, a contract is just as binding on one party as on another, and if not lived up to will, in the long run, work the downfall of the transgressor. Right here in your own district this present season there have been unholy alliances between unscrupulous packers and unscrupulous growers. Growers who have made contracts to deliver their goods at an agreed upon price to packers have jumped their bargains and delivered their goods to others for a consideration. By far the largest loss through such dealings will accrue to the packers themselves in the course of time; but a grower's contract is, both in statutory and moral law, as binding as any one else's. You expect the man with whom you bargain to live up to his word, whether he wins or loses, and you should certainly do the same. This class of growers in such a community as California must, however, be small in number.

In the matter of selling your goods, I have no patience with the theorists who get up and argue by the year that this or that particular method is the only way that any product of the soil can be sold to advantage. I do not think there is any one way. I believe there are a great many methods of selling or handling your goods, each of which is to the best advantage under certain circumstances and to certain individuals. With a state as large as the State of California and individuals' interests as diverse as they always must be in this State, it is sheer nonsense to talk about selling all the fruit, all the vast production of our orchards, in various lines, under any one system, no matter how theoretically perfect it may seem to be. There are always going to be different methods of selling just as surely as no two people think exactly alike on all subjects. Coöperation, so far as uniformity of action on anything like a unanimous scale is concerned, has proved an absolute failure; not in theory, the theory of it is perfect, but in practice. In the matter of selling your products, nearly every case is different in some particular, and for this reason one method is the most advantageous in one case and another in another. There is no one royal road to the highest price for fruit.

In an effort to get the best possible price for your product, you must, of course, keep posted on general conditions and tendencies. Generally speaking, it pays best to produce a less quantity of a first-class product handled in a first-class way. The fixed expenses of interest on your land investment, most of the expenses of care for and handling the product, and all the expense of transportation, are the same, whether your product brings the bare cost of getting it to market or a substantial profit to you. It is the great mass of low-grade stuff on the markets generally that keeps prices down and discourages consumption. Of course, there are certain conditions that require a certain class of product, and where a producer is catering to a particular trade, he wants the goods that that trade demands; but make them the best that they can be for the particular conditions that are being catered to. The principle is the same.

A matter which is very largely overlooked by fruit-growers in disposing of cured fruit is the matter of carrying expenses. I do not advocate jumping at the first offer that comes your way; but there is a large class of fruit-growers who argue along these lines, "If Mr. Buyer can afford to pay the price he is offering me, my goods must certainly be worth more money, because he expects to make something, so I had better keep them myself and I shall get more later on." Whether or not a product should be held depends entirely on circumstances over which the grower himself has very little control. Growers, however, should take into consideration more generally the carrying expenses; loss of interest, insurance and shrinkage. Now this matter of shrinkage is one of more importance than many think. If the grower holds his product, he is going to lose by shrinkage, and it is very material in most cases, amounting to a very noteworthy percentage, and the grower in deciding to hold must take this into consideration.

There is one more point that I have left for the last because I want to make an effort to impress on you my ideas on this subject as strongly as possible: Futures. The wrecks that fill up history in fruit-trade circles are responsible in large part to future selling. As a rule growers do not indulge so largely in the gamble in futures as do the commercial packers, but a large number of the evils of the business and the general hard feeling between growers and buyers is directly or indirectly due to dealing in futures. It may be set down here that it is not only improbable, but exceedingly unlikely, that the time will ever come when the speculator and dealer in futures will cease to exist. In the first place, the human race has an inborn instinct to gamble, which, so far as my experience goes, is general in one form or another. It may not be draw poker and it may not even be a slot machine for cigars, but the individuals in whom the gambling tendency does not manifest itself one way or another are exceedingly few and far between. Hence, of course, we are always going to have speculation, and the speculator must naturally take a chance on the future. But of all the practices which experience has shown to be prejudicial to peace, harmony, and financial success in the fruit business, dealing in distant futures takes front rank in the grand stand.

This is not a packers' meeting, so there is no call to discuss the subject from that point of view. It may be said, however, in passing, that the packer is between two fires in this matter, being liable to get in trouble either way, buying or selling, but the effect on the market to the grower is usually detrimental. It is safe to say that, one year with another in the long run, the less gamble the grower takes with his product, the better he will come out. Wait until you have something to sell; then when you know what you have to sell, both in quantity and quality, take the best price, coupled with reasonable conditions, that offers at the time buyers want to buy, and perhaps you will not get the very top of the market, but at the same time if you are dealing with honest people, and I can not impress this latter point too strongly on you, you will get the best average that your particular field of activity warrants. When conditions seem in your judgment to indicate better prices later on, of course, by all means wait. But in this connection there is an analogy with the stock market in that there are but few who are fortunate enough—luck more than judgment entering into the matter—to obtain the very highest ruling price during a season, because a market must be on the move one way or the other most of the time. When it stops going up it begins to come down, and it does not take much illustration to have a fruit-grower see that it is vastly easier to sell on a rising market than a falling one.

Produce the very best fruit your particular case warrants. Keep posted on general conditions and local tendencies. Speculate as little as possible. Be honest yourself, and see to it that you only do business with those who are. I think that sums up the requirements in approaching the aim of the fruit-grower.

PRESIDENT COOPER. The vice-presidents appointed are F. W. Power and W. A. Long. The next on the program is "Growing the Eucalyptus," by Dr. W. H. Miller.

As Dr. Miller could not be present at this session, his paper was read by the Secretary.

THE GROWING AND USES OF EUCALYPTUS.

By DR. W. H. MILLER.

The word "eucalyptus" is from the Greek, and means "well concealed," referring to the pods of the tree containing the seeds.

The eucalyptus, commonly called gum tree, belongs to the natural order *Myrtaceæ*, growing natively in Australia and adjacent islands, but now grown exotically in most civilized countries whose climates permit. There are more than one hundred and fifty species, which differ greatly in growth and quality of timber. Many are dwarfs or shrubs, while others rank among the largest and tallest trees in the world, very closely crowding, if not exceeding, our own great sequoias in magnitude. Baron von Müller, of Australia, speaks of recorded heights of over 400 feet and diameters of 35 feet. One tree furnished a log 220 feet to the first limb, 12 feet in diameter at the top and 30 feet at the base; but the growth of these trees does not warrant the opinion that they will reach such dimensions elsewhere. The native wood of all eucalypti belongs to the hardwood family, but considerable differences occur in the species as to the degree of hardness and strength—the iron barks being usually much heavier and harder than the other division, known as stringy barks. This title is given them because they shed their bark in long fibrous or stringy bands. Iron barks do not shed their bark, or do so in flakes or scales.

In answer to the most common question one hears, "What are you going to do with them?" People seem to forget that a large forest tree has its uses. If one would think a moment he will see that one can scarcely enumerate its uses. Some of them are these: this timber when sawn makes flooring equal to maple, and maple floors are worth something; when made into shingles they resemble slate and are almost as durable; the finest quality of hardwood furniture, including all kinds of inside hardwood finish; all parts of the woodwork for wagons and agricultural implements, and for building railroad coaches, and in the construction of ships.

These trees furnish also superior poles for telegraph, telephone, and electric light wires; timber for the building of bridges; piles for wharves, and railroad ties. Any railroad company will buy all you have to sell for this purpose, and farmers may use them for fence posts. Wood also is becoming higher from scarcity, and these trees make splendid wood. Every farmer should have a timber lot and raise his own wood. In fact, wherever hickory or oak is required, eucalyptus can take its place.

As a source of honey, their bloom is of great value, producing a splendid quality of honey and protecting bee men against the loss of their broods from drought, since they are in bloom every month in the year.

As a source of oil, the leaves and twigs of the blue gum are rich. This oil in its purified form is becoming more widely used as a household remedy, as it cures many common complaints and is far safer and better than patent medicines for sores and the healing of wounds. Its antiseptic properties are excellent, being non-poisonous. The crude oil is used in steam boilers to prevent incrustations from taking place. The oils from some species are sweetly fragrant and are used for perfuming soaps.

There is no tree on the globe that gives beauty and grandeur to a county equal to these stately trees, ever green and ever aspiring. Scattered and neglected in the haphazard planting of this State as they are, to remove them would sadly blemish her beauty. It would no longer appear the comely and charming California. Go through the districts of meager forestation and judge for yourself. So, as an ornamental and shade tree; for the sheltering and protection of stock against storms and winds; it is needed for windbreaks to orchards and vineyards. It is of great value for the foresting of barren mountainsides; and in the relief from blistering suns and the modifying of climate it has no peer, marvelous and diversified as its uses are.

The most distinctive characteristic of this genus is its rapidity of growth, averaging, under favorable conditions, about 12 feet per year of wood, whose tensile strength equals the best hickory, and producing a tree in twenty years equal to an oak that required more than two hundred years to grow.

Of the seventy-five or more varieties growing in the United States, two species only have been planted in quantities for commercial purposes, and these to no great extent. They are the blue gum, or *globulus*, and the red gum, or *rostrata*. The other varieties are little known. The State and the United States governments are carrying out experiments to determine desirable varieties for recommendation, but individuals and private corporations are lending great help in this regard, and very soon proper kinds can be selected with safety, so when planting is done on an extensive scale trees suitable for climate and lumber can be secured without danger of failure. It costs to plant trees and later on to learn that the wood is not desirable or that they will not endure the climate.

The varieties we have found that will not stand the frost or heat of Kings County (and this, perhaps, means the San Joaquin Valley) are *diversicolor*, *punctata*, *cornuta*, *salubris*, *citriodora*, *maculata*, and *corynocalyx* or sugar gum. There are perhaps many more, but they have not been tried by us. Of those tried by us that have shown hardiness of growth in this climate are the following (named in the order of their sturdiness, common names given also when they have any): *rudis*, *robusta*, *viminalis*, *rostrata* or red gum, *tereticornis* or gray gum, *globulus* or blue gum, *crebra* or narrow-leaf iron bark, *siderophloia*, *resinfera*, and *stuartiana*.

The *rudis* has been planted somewhat extensively in this section as an avenue and shade tree, and it certainly commends itself as a shapely and hardy tree. What little investigation we have made of its wood indicates that it is most excellent, close-grained and hard, taking a fine polish. Its rate of growth seems good. It is claimed, however, that it does not maintain its early fast growth very long.

The *rostrata*, or red gum, is a grand tree. No one can make a mistake in planting it.

These two varieties for ordinary use are the best at present to plant in the San Joaquin Valley, making first-class timber, proof against frost and a delight in sunshine, can withstand drought, and thrive well in alkali soil.

The *tereticornis* we hope will prove better than either of these, growing more rapidly and much straighter than the *rostrata*, with better grain and with equal strength. The *rostrata* has a bad fault of wanting to grow crooked. This can be corrected by cutting off at the ground level when one year old, then a shoot will grow up straight and with very little loss in time. This cutting process holds good for almost all varieties. The great majority of eucalypts when cut at any age send up shoots very rapidly, reproducing themselves in much less time than was required to grow at first. So, when a plantation is once established, crop after crop may be harvested indefinitely without replanting. Young seedlings for planting in the field should be about fifteen to twenty inches high and it is best to plant not later than April. February is the best time for planting, in order that a full season's growth may be had. It enables them to withstand the severe frost that we usually have. When planted, water should be poured around them to settle well the dirt, and by irrigating them during the summer a much better growth can be obtained, although they do well in this section without watering after planting.

The *viminalis* is a hardy tree, grows rapidly and stands the climate. An example of this tree may be seen on the old Kanawyer place in Grangeville. Two years ago this tree was measured and found to be 126 feet in height, with a circumference of perhaps 20 feet. The wood, however, of this species is not of the best, nor is the wood of blue gum equal to other varieties, and this tree when young is likely to be killed by frost.

The pioneer eucalyptus man of California is the Hon. Ellwood Cooper of Santa Barbara, who is at this meeting. To him belongs the credit of delivering the first lectures and writing the first book upon eucalyptus in this country, also systematically planting about two hundred acres of the different species of this tree, and I am told that it has been for a long time a source of a handsome income, although his planting was upon land not well adpated to other purposes, being mostly hillsides and ravines. If the efforts of Mr. Cooper are taken up and continued by interested and able men, the permanent benefits to California and the Southwest will be incalculable. If the San Joaquin Valley from Tracy to Tehachapi was avenued and blocked off with these trees, what a delightful trip it would be through it, besides yielding an income of $2,000 per acre every six years. Indeed, how charming.

To those who may wish to plant, it is perhaps cheaper to buy the young plants from some reliable nurseryman than to undertake to grow from the seed, as it is difficult and requires special care and training to successfully grow from the seed.

PRESIDENT COOPER. The business, as laid down in the program for this afternoon, is completed. If any one has any suggestion or any remarks to make, or any discussion on any of the essays that have been read, he is now in order.

REMARKS ON COOPERATION.

MR. A. R. SPRAGUE. As there appears to be an abundance of time, I beg to say a word in connection with Mr. Rowley's paper.

I did not say anything at the time, because Mr. Rowley was very guarded in what he said about coöperation being a failure in California. Coöperation in California has had its successes, which have been continuous, and its failures, which have been almost as continuous. It would be just as ridiculous for us, having been unwise in purchasing a particular kind of engine, for instance, to therefore say that all gasoline engines are failures and we will use none henceforth and forever, as to say, after having chosen a bad method and bad piece of machinery with which to attempt to effect coöperation, and having found that it has failed, that coöperation is therefore a failure.

Now, my friends, coöperation is a success. It is not a theory. It is something which is capable of demonstration, and is being demonstrated every day in the year. The reason why we have had so many failures is because we have so many times tried to do it wrong.

MR. ROWLEY. I was not speaking of coöperation as applied to particular communities, but only as to coöperation which would include the entire coast.

MR. A. N. JUDD. I would like to hear from Mr. Newell, of the State Board of Horticulture, in Oregon.

MR. W. K. NEWELL. Mr. President, ladies and gentlemen of the California Fruit-Growers' Convention: I have been very much interested in the discussion of this question of coöperation. It is one of the most important we have confronting us now. I am surprised to hear any one question that coöperation, properly carried on, is not a success. It is true we have failed in our coöperative societies, but it generally had been because we tried to start at the top instead of at the bottom. We prune-growers in Oregon, like you in California, tried to organize the whole State at once, and could not do it. Coöperation wants to begin at the bottom instead of at the top. After we failed in that way we began at the other end of the proposition, and now we have a number of small coöperative societies in Oregon that are making a shining success. The Hood River Apple-Growers' Union is the best of any of them. It is the most widely known, and being a pioneer in that line will serve as a type. The apple-growers in the Hood River Valley found the first thing they wanted to do in coöperative marketing was to produce the apple wanted, and the marketing question was almost entirely solved. To show their great success we have got to go back and show how they grow their fruit. Every apple-grower on Hood River believes, and firmly believes, that Hood River Valley can grow the finest apples in the world. We know they can't grow any better in the United States. They preach that from the housetops and they make everybody believe it. They are now the highest-priced apples in the world. Their good work begins in the orchards. As soon as the fruit sets in the spring of the year and they find that the trees are overloaded, as they generally are, every grower goes into his orchard and begins to cut them out. They grow to full size, and we allow no codling-moth to grow between two apples and creep into both of them. That same thing is kept up, and in the latter part of August, when they are sure of the crop they will have, just how many boxes can be estimated of the different varieties and different sizes, the Hood River Union, through its manager, sends out word to every fruit dealer in the United States, every commission man or buyer of any kind in the United States, England, and Germany that they can reach, and they have a complete list of every one of them. The manager tells them what they are going to have for market this year, and then asks for bids. They formerly tried consigning them and all that sort of thing, but this year and the last two years they have called for competitive bids, and the buyers have fallen all over themselves and come from all over the United States to submit bids for that crop of apples. Their crop this year amounts to three hundred thousand boxes. This year they sold their best apples at $3.15 a box, and prices on down, being an average of something like $1.25 a box for the entire crop produced in the valley. The biggest dealers in the United States were bidding against each other for those apples. Those dealers know from the record of the Hood River men that every box they buy is just as good as any other, and every box in a car is just as good as every other box. They know the apples will be of the same size and that the rows of different standards, and the number that go into a box, will be the same. Every apple is counted; every box of apples is counted. It contains so many apples according to the size, and the number of apples is stamped on the outside of the box, and there are never any mistakes about the number of apples. They allow no man to pack his own fruit. They have found, while any apple-grower on Hood River can tell when his neighbor has a poor apple, he is not quite so sure about his own. So the union hires its own packers, who are not growers, and no box of apples with the Hood River Union label on is allowed to be packed by anybody but those union packers. Every packer must put his own number on the box, so the manager of the union may know who packed that box. If any complaint is made about the packing, if the complaint comes in the second time, that packer is reprimanded, and if the third complaint comes in, he is "fired" and not allowed longer to pack.

The reason that coöperation so generally fails is when we start in to coöperate we begin to look at the market end of it and think we have got to do the whole thing—that we have got to supplant the commission men. And there is where the mistake is made. Coöperation wants to include the commission man. We can't exclude him. We can't do it all. Let the commission man know we have the fruit to sell, and ask his warmest coöperation to help us sell. The Hood River Union has no warmer friends anywhere than the commission men of the United States. They are willing to trust absolutely to their honesty in putting up the goods, and are glad in every way to coöperate with them in selling. They have no trouble any longer in selling. The only trouble is to get enough of it to supply the demand. I thank you for your attention. (Applause.)

(At this time an adjournment was taken until Wednesday, December 5, 1906, at 9:30 A. M.)

PROCEEDINGS OF SECOND DAY.

WEDNESDAY, December 5, 1906.

The Convention was called to order at 10 o'clock A. M.

PRESIDENT COOPER. The first on the list this morning is an address by F. W. Power. I introduce to you Mr. F. W. Power.

ADDRESS BY F. W. POWER, OF CHICO.

Members of the Pacific Coast Association of Nurserymen, Fruit-Growers, and Horticultural Commissioners:

It is customary to fill the President's chair with men able to entertain with either their oratory or their wit. We have listened to hearty welcomes and able addresses. I will only express my thanks for the honor you have shown me; the hearty support aud coöperation of members during the past six months; and the courtesy and active aid given by the officers of the Fruit-Growers' Convention, and especially Mr. Isaac, the Secretary, who has assisted materially in making this a joint convention of all the fruit-growing interests. I further ask support during this, our fifth Nurserymen's Convention, and pardon any mistakes that I may make.

When the excuses for not attending this Convention commenced coming in from California nurserymen, in answer to various circulars and letters sent them, stating they were too busy, etc., and we all are at this time of the year if we do any business at all, I felt like giving the answer received by a politician, which you have doubtless all read. He was to speak at a meeting on a certain night, but just before the day of the meeting a heavy storm destroyed the railroad bridges. He telegraphed to a friend, "Washout on line. Can't come." He was very much surprised a little later to receive a reply, "Borrow a shirt and come anyway."

As Mr. Cooper, the Commissioner of Horticulture, has called attention to the matters needing the attention of the fruit-growers, I will confine my suggestions more especially to the nursery interests and inspection.

The past season has so far been most prosperous, and promises even better for the balance of the season, and from the present outlook there will be but little salable stock to carry over. We all come here with friendly feelings, not only to each other, but to the Commissioners of Horticulture and fruit-growers as well. All are working along different lines to the one great end of making the Pacific Coast the greatest and best fruit-growing section in the United States.

Although up to the present we do not have written reports from all our committees, they have done much and worked cheerfully.

I have called upon several nurserymen to assist in increasing the membership and making the meeting a success, and in nearly every case they have responded cheerfully, and I am pleased to say that our membership has increased by ninety per cent since the first of July. This was not accomplished without much work, by both officers and members, and in some instances my zeal for the Association was so great that I almost, if not quite, tried the patience of some of my friends.

While this meeting is held at the most inconvenient time for nurserymen to leave their business, there is a good attendance.

We have introduced at this session the badges for members and badge book. This I am certain you will find very convenient for finding members with whom you are not acquainted. We hope to make the badge book a complete nurserymen's directory of the Pacific Coast.

The legislative committee is doing a good work. Mr. Eckert, of the Washington committee, is attempting to secure a joint conference with a like committee of the fruit-growers of that State, looking toward a revision of their law at the coming session of the Legislature. Mr. McGill, of the Oregon committee, is also busily engaged, along with others in the various states. The legislative committee should be thoroughly organized, so that all members in each State would work in harmony, and by having a good active member in each State to watch new legislation much can be done toward a more uniform inspection law. If the members of the legislative committee of each State would make it a point to meet a like committee of fruit-growers and inspectors and discuss proposed legislation, all could work in harmony when the bill was finally introduced.

The transportation committee has done little during the past six months. I have called upon one of the General Freight Agents of the Southern Pacific Company and secured data concerning carload rates. As most of you know, in the "Western Classification" the following class B rates are listed:

Car 36 feet 6 inches or less, 16,000 pounds minimum.
Car over 36 feet 6 inches and not over 45 feet 6 inches, 20,000 pounds minimum.
Car over 45 feet 6 inches, 24,000 pounds minimum.

The Southern Pacific Company makes an exception to this, making 20,000 pounds the minimum without regard to size, but allowing class C a lower rate, and in many instances 20,000 pounds class C is less than

16,000 pounds class B. The following table is prepared showing comparative carload rates:

Class B	16,000 pounds.
Class C	20,000 pounds.

From several points showing exact difference. The point selected usually being one where a nursery is located or a common point.

If the freight committee will get acquainted with the railroad officials and have facts and figures to present, they will find them, at least, open to conviction; but you must know what you want and be able to tell why you want it, and how it will benefit the railroad, and if a lower rate is asked we must be able to tell approximately how much would be shipped.

At the present time every nurseryman wanting to ship a carload over the Southern Pacific system orders the largest sized furniture car, as he must pay 20,000 pounds minimum, and I am certain that if the Southern Pacific Company would grant a 16,000 pounds minimum on small cars they would be actual gainer in amount received as carloads. Furniture cars are scarce and hard to get, while 36-foot cars can be had at nearly all times.

We can get a 16,000 pounds class B minimum on 36-foot cars if we want it, and ask for it as an Association through some officer or special committee, but could not get a promise of a 16,000 pounds minimum at class C rates. They want to know, however, that it is the wish of the Association and not of one company.

The secretary is required to do much work with no compensation, and I trust the time will soon come when our membership will be large enough to warrant our paying a small salary for this.

Representation at national associations is of great interest to our work, such as the American Association of Nurserymen (and every member of the Pacific Coast Association of Nurserymen should also join the American Association of Nurserymen); and we should also be represented at the National Association of Entomologists and Nursery Inspectors, either by a representative of our Association or through the American Association of Nurserymen.

More can be done toward uniform laws in this Association than any other, for it is there that the various State laws are discussed.

While we have never been able to agree upon a uniform method of grading stock, we should continue to work along that line, as different methods of grading are sure to cause confusion.

In the appointment of committees I would suggest that the by-laws be changed so that the president appoint the chairman of each committee, or, in one like the legislative committee, a chairman for each State, and that the chairman select the other members, as often the committee is so scattered that they can not do good work.

Like one of our most prominent horticultural writers, I "look upon the nursery business as the foundation of our fruit-growing. All trees come from the nursery and the variety of fruit planted depends very largely upon what the nursery can supply." "Fruit-growing is one of the most profitable and pleasant rural occupations," and the time should come when nurserymen, inspectors, and fruit-growers should all work in harmony. Much more good can be accomplished by all meeting together, discussing various grievances and deciding upon a method of joint coöperation, than by each of the three interests working at cross purposes, and I trust that great good may be done by this joint meeting.

PRESIDENT COOPER. Mr. W. K. Newell is the president of the Horticultural Commission of the State of Oregon, and I will ask Mr. Newell to come forward and take a seat on the platform. The vice-presidents appointed for this Convention to assist, are F. W. Power, whom you have just heard, and W. A. Long. Mr. Power will preside at the Convention this morning, and perhaps this afternoon, so I introduce to you as chairman of this Convention Mr. F. W. Power.

VICE-PRESIDENT POWER. The next paper is by Mr. S. A. Miller, of Milton, Oregon.

BENEFITS TO BE DERIVED FROM THE PACIFIC COAST NURSERYMEN'S ASSOCIATION AND THE AMERICAN NURSERYMEN'S ASSOCIATION.

By S. A. MILLER, of Milton, Oregon.

Men have been, and always will be, benefited by proper intercourse, socially and commercially. No one is independent. We are all dependent each upon the other. The early history of the original thirteen states furnishes a good example of what has been accomplished by united effort. Before a compact was made and a union formed, they were all in a state of disorder; a prey to their foes at home and abroad, and without financial resources with which to carry on their own governments and prosecute a successful warfare for liberty and peace. However, after they decided to unite, a proper executive was appointed, with his necessary associates, laws formed for their government, and order established out of their confused condition. They gained the respect of their foes, and secured everlasting peace for themselves, their children, and generations which followed them. We, here to-day, enjoy the fruits of their coöperation and concert of action. We are the greatest and grandest nation on the earth to-day, because its foundation was laid upon this principle. So we, here assembled, may well seek to secure to ourselves the lasting benefits to be derived from the united effort from east to west, and up and down our coast, of every man who is engaged in the nursery business. Our association makes it possible to organize in detail, and adopt a policy by which we shall be governed and our growth promoted. The benefits to be derived from our Pacific Coast Nurserymen's Association have hardly been realized; we are scarcely beyond the formative period in our work, and our work is large. It is well that we can have these occasions, where we can mingle together and exchange our plans and ideas. We have small need to recall the past to convince ourselves of the tasks to which we must set ourselves with determination, the accomplishment of which will secure to ourselves greater returns in our chosen calling.

The American Nurserymen's Association has entered upon certain lines of work, and some very satisfactory results are already seen. While we would prefer to be originators, not imitators, yet the work undertaken by the American Association is well worth our careful study and imitation. By the efforts of its officers and special committees, gratifying reductions have been secured in freight rates; the minimum of car lots lowered; burdensome classifications have been removed, and other concessions from the railroads secured, by having their attention called to the nurserymen's business with its needs. At their last meeting a committee was appointed to consider the advisability and ways and means of employing a commercial agent to look after the interests of the Association in the line of reductions in freight rates, lower classifications, and other matters that would affect the pockets of the members of the Association. The committee was unanimous in their decision that such a man could be profitably employed by the Association, but unfortunately the Association was without funds to pay his salary and expenses. An increase in the membership dues was made, but this will not make up the deficit. However, that this plan may be carried out, members who were present at the meeting pledged themselves to make up the deficiency. It was the belief that the burden of this deficiency should not be wholly borne by the few members who were at the meeting, but that all who will be benefited by the work that will be accomplished by the employment of a commercial agent will wish to bear a part of the expense. This work is in the right direction and will result in untold good to us all, I am sure, if it is pushed to a successful finish, and the money will be well spent. I believe this Association and its members will receive large returns from this, and we should take some action as a body, and individually, in reference to it. The work of the American Association does not as yet fully cover our field of operations, only reaching to the Rocky Mountains. This territory west of the mountains is in charge of the Trans-continental Freight Bureau, and we should take up the work with them, and secure the same concessions from it, if possible. This would relieve us of many burdens, and be of great assistance to our work. If we can secure prompter delivery of freight shipments, avoiding vexatious and costly delays thereby, this Association will have rendered valuable assistance to its members. We can not secure this individually, but unitedly I believe we can, if it is undertaken in the proper manner and spirit.

Much benefit would accrue to our business if we would make a systematic effort looking toward more uniform legislation touching our work. Every legislative measure which has a bearing on our work should be watched. Proper action should be taken to secure such changes in existing laws as may be necessary to relieve us of burdens and losses. Your attention will be called to the need of more uniform inspection laws. We should throw our influence with the American Association, and work for a national inspection law which would remove many hindrances and costs.

The uniform grading of nursery stock would prove of great value to us. Scarcely a season passes but what some one, or all of us, find ourselves long or short on some varieties. With a proper system of grading we will be enabled to get from each other just the kind and size of stock we need, thus avoiding disappointments in shipments, and to our customers. Individually it would be slow work to bring this about, but as an association we can do it with but little effort. I do not believe this will or should lead to unifying of prices. We must work under varying conditions and circumstances. Such matters as prices must be left largely to individuals; but as we mingle here together and at our gatherings, these matters are bound to receive more or less attention, and a molding influence will be exerted in right lines. And so it will be with other matters. The exchange of experiences and ideas will be helpful. Reports as to crop conditions will enable us to relieve our wants as well as those of others, early in the season. Every man has a method and system of doing his work, and by comparison we can adopt improvements and discard cumbersome and antiquated methods. Improvement is the order of the day, and we can secure it here. It has seemed to me that a good fellowship and feeling have sprung up and been strengthened as we mingle together from time to time, and as we meet our fellow workers; if we should happen to have any differences, often a word of explanation will remove them all when we meet face to face.

This organization affords a means of mutual protection. Occasionally circumstances arise that were they to confront us as individuals we would be quite overwhelmed, but by having this Association to help fight our battles we are largely relieved of the distress and worry. The strength and backing we can give unitedly to this Association will secure respect and consideration of our rights. Therefore, we should support it with our influence and means as needed.

This organization may aid the patron, as well as its members, by suppressing unscrupulous persons who may engage in this work. It is a duty we owe to our patrons as well as to ourselves to drive out every unfair and unprincipled man engaged in this business, either as a grower or as a dealer. Let us raise the standard, and not let it be seen among the dishonest and greedy.

A good and beneficial work could be done by having proper committees who would seek out and classify our fruits as to their adaptability commercially to the different sections; also prevent fraud and loss by testing new varieties of fruits as they are brought out, and recommend them or reject them according to their merits. Similar or worthless varieties should be weeded out and their multiplication discouraged.

Many times it seems there is little in common between the nurseryman and his patron, and much unjust criticism is aimed at us by those who are not acquainted with our work. Much uncalled-for annoyance might be avoided if we could get our patrons to keep in touch with the growth of horticultural work, and I believe we can secure their coöperation by lending our influence and support to every legitimate means which will disseminate horticultural knowledge.

The social benefits derived from our Association must not be overlooked. If we remain to ourselves, engrossed with our cares, from year to year, we soon forget there is any one else in the race but ourselves, and the selfishness we possess by nature will again control; but as we mingle together, lay our plans for mutual good and advancement, our minds are broadened, and our work takes on new aspects. We should seek enjoyment with our work, because all work and no play makes Jack a dull boy, as we all know, and doubtless have felt some time in our lives. But the rest of the adage must not be forgotten, that no work and all play makes Jack a mere toy. I do not think this has been done. I am glad for the good and substantial meetings in the past, and for this one that is, and others that are to come. However, we can not expect the full measure of good can be accomplished or wrought out during these few hours we have allotted to this work. These meetings afford opportunities to render reports and summaries of our work, which has been, or ought to be, done between times. The real work should be carried on when we go to our homes. Carry this Association and its needs around with you wherever you go, and this will make it a success, and pay larger and oftener dividends than anything else.

So in closing I will say again that the benefits we will derive from our Association will depend and be measured by the effort we put forth in its behalf; the degree in which we coöperate with and for each other, for the accomplishment of one common purpose.

VICE-PRESIDENT POWER. The next paper is by Mr. Leonard Coates, of Morgan Hill.

MR. COATES. Mr. President, Ladies and Gentlemen: The subject that has been given to me, of course, takes a more narrow and more local view than that of the speaker who has preceded me, and the more I think of it, the more appalling, almost, are the multitude of subjects which ought to be presented before a Pacific Coast Association of Nurserymen—particularly so because this is the first time we have met together. Our interests as a coast association are identical in many ways. At the same time, our conditions—physical conditions—in California are so different, particularly in this great central valley and the southern part of the State, that many subjects would have to be more or less localized. I shall only make a few remarks and they will be generally local, as will be indicated by the subject.

THE NURSERY BUSINESS IN CALIFORNIA; ITS PRESENT NEEDS AND FUTURE POSSIBILITIES.

BY LEONARD COATES, OF MORGAN HILL.

In speaking briefly on this subject, I am strongly tempted to indulge in retrospection, for, while the "present needs" is a difficult phase to treat of, and one on which there would be many opinions, the "future possibilities," while almost limitless, are also largely imaginary. It becomes almost necessary, in fact, to allude to the past, that a more comprehensive view of the whole may be obtained. By this I do not mean to inflict upon the members of the Association a sketch of the early nursery ventures in California, although I have abundant data therefor, having had occasion, some years ago, to search all known records. These data now, in view of the destruction of the San Francisco libraries by fire, have, however, an added value.

All of the earliest nurseries were located near the Bay of San Francisco, or its branches, or along river banks near to tide water. It did not seem possible that elsewhere trees or plants could be grown, in a climate where no rain fell for six months at a time. Perhaps I may select four names as typical of our California pioneer nurserymen without detracting from the honored memory of others equally deserving: B. S. Fox, John Lewelling, James Shinn, John Rock. The work of these men lives on, and, as an instance of their enterprise, it is worthy of mention that in 1859 B. S. Fox had in his nursery in Santa Clara County 263 varieties of apple, 324 of pear, 89 of peach, 71 of cherry, 56 of plum, 14 of nectarine, 18 of apricot, 21 of currant, 86 of gooseberry, 12 of raspberry, 122 of foreign grapes, 21 of fig, etc.

In 1858 W. C. Walker of San Francisco exhibited 264 varieties of ornamental plants in pots, and about the same time A. B. Smith of Smith's gardens, Sacramento, was propagating fruit trees on a large scale, and also demonstrating the profit in growing fruit in those days, the crop from two of his peach trees netting him in one year $326.50.

It is well to look backward, occasionally; our own achievements are sometimes dwarfed by comparison with those of others who have preceded us, and whose work has been accomplished under so much greater difficulty. These early pioneers in the nursery business in California attained success without the aid of railroads or any regular hired labor. California was then a wilderness, being gradually peopled by adventurers drawn here by the gold excitement of '49 and '50.

We have learned—or might have learned—many lessons from the experiences of the pioneers, and still we know but little.

PRESENT NEEDS.

The nursery business in California needs, first, and more than anything else, just such men as those I have named. We want not only men who are skilled horticulturists, but shrewd men of business, who ought to be able to see something of what the future has in store. Compared with nurseries in the Western, Southwestern, and Eastern states, our largest concerns here are but pygmies. It may be said that demand alone will create the supply. In a sense this is true; but supply also, and the naturally accompanying advertising, creates demand. There are may ways by which the nursery business in California might be augmented. Why is it that Eastern firms can do such an enormous mail-order trade, and we can not do it here? We grow the seeds here, wholesale them East, and let the California public buy them of the Eastern houses, to plant near where they were grown. The retail market of the United States is ours, or a good share of it, for seeds, and also, in time, for bulbs. These latter are being grown successfully, and it only requires a knowledge of the necessary conditions, and an application of that knowledge, to insure success with all branches of commercial bulb culture in California.

Must we "look backward" again, some fifty years, to be reminded of the "incredible anomalies" of the California climate? In 1857 Dr. Horace Bushnell in *The New Englander* said: "Whoever wishes, for health's sake, or for any other reason, to change the scenery or the objects and associations of his life, should set off, not for Europe, but for California. * * * It can not be said of California, as of New England, or of the Middle States, that it has a climate. On the contrary, it has a great multitude of them, curiously pitched together, at short distances, one from another, defying, too, not seldom, our most accepted notions of the effects of latitude and altitude and the defenses of mountain ranges. * * * All the varieties of climate, distinct as they become, are made by variations wrought in the rates of motion, the courses, the temperature, and the dryness of a single wind, namely, the trade wind of the summer months, which blows directly inward all the time, only with much greater power during that part of the day when the rarefaction of the great central valley comes to its aid, that is, from ten o'clock in the morning till the setting of the sun. * * * When this is fully comprehended, the California climate, or climates, will be understood with general accuracy. We now return to the middle strip of the great valley, where the engine, or rather boiler power, that operates the coast wind in a great part of its velocity, is located. Here the heat, reverberated as in a forge or oven—whence Cali-*fornia* (*Caleo* and *fornan*)—becomes, even in the early spring, so much raised that the ground is no longer able, by any remaining cold there is in it, to condense the clouds, and rain ceases. * * * So, crossing the Sonoma Valley, he would come out into it from the west, through a cold, windy gorge, to find orange trees growing in General Vallejo's garden, close under the eastern valley wall, as finely as in Cuba. In multitudes of places, too, on the eastern slopes of the mountains, he will notice that the trees, which have all their growth, in the coast-wind season have their tops thrown over like cocks' tails turned away from the wind. This cold trade wind, being once lifted or drawn over the sea-wall mountains, and being specifically heavier than the atmosphere into which it is going, no sooner reaches the summit than it pitches down as a cold cataract, with the uniformly accelerated motion of falling bodies. * * * The winter climate is the trade wind reversed."

These "climates" of California constitute our most valuable asset. It is because of this that it is no idle statement that nowhere else in the world, in the same area, can be successfully grown so great a variety of crops as in the State of California.

Many carloads of trees are shipped into California, but when did we hear of a carload being shipped out of the State? "California" is the name which sells fruits all over the length and breadth of the land. Why is it not likely that thousands of planters would like California-grown trees if they could get them? New Jersey and New York nurserymen grow hundreds of thousands of roses annually in California for their Eastern trade, because in eight months they can get a better plant than they can there in two years. For more than half a century seed and bulb collectors from Europe and the Eastern states have been searching California for new species, and supplying nursery firms and seedsmen all over the world. Why can not these native seeds and bulbs be cataloged and advertised extensively in the United States and abroad in order to work up a direct trade with the planter? Or why can not these native plants, shrubs, and trees be grown extensively for retailing outside of our State? You will, to-day, find in the parks and private grounds of people of refinement in Europe more specimens and a larger variety of California trees and shrubs than can be found at home.

We need a more fraternal spirit, and the calling of this meeting of the Pacific Coast Nurserymen's Association is, I hope, a means to this end. Not only is there ample room for all now engaged in the business, but room for many more, of the right kind. We must sink all petty jealousies and suspicions, let our views be broadened, and let us be ready to "live and let live." There are many other "present needs," general and local. Of the latter, a wholesale nursery for the growing of apple, pear, cherry, and plum seedlings is badly wanted; we are still in that extravagant spendthrift stage when we continue to send money away for what we can produce at home.

I would prefer to deal with hard facts rather than to plunge into the realm of prophecy and let the imagination run riot in an attempt to portray the "future possibilities" of the nursery business in California.

And yet they have already been hinted. Give us more men of enterprise and horticultural ability, give us better transportation facilities, give us a parcels post, and there is practically no limit to the growth of the nursery business in California.

VICE-PRESIDENT POWER. The next paper is "European Methods," by Mr. J. R. Pilkington. Mr. Pilkington is not present, and I believe has not sent his paper. We will, therefore, pass over to the paper on "Fruit Varieties," by Prof. E. J. Wickson.

FRUIT VARIETIES MOST POPULAR ON THE PACIFIC SLOPE.

BY PROF. E. J. WICKSON, OF BERKELEY.

It was my privilege to prepare a paper for the Convention of the American Nurserymen's Association held in Texas, in June, 1906, on the "Specific Requirements of New Varieties in California Fruit-Growing." In order to ascertain what changes in the characters of varieties would, in the opinion of the growers, be desirable, it seemed advisable to ascertain first which of the existing varieties are most satisfactory to them and what specific modifications would enhance their value from a grower's point of view. For this reason I requested my correspondents to name their best varieties of the different fruits and to use them as standards in describing desirable variations. One result of this inquiry was a fuller designation of the most popular old varieties than had been secured hitherto. When I received the invitation to prepare something for your meeting, it occurred to me that I could compare the growers' conclusions as to the varieties best for planting with the nurseryman's conclusions as to varieties which he considered best to propagate for sale, and in this way approach the popularity of variety from two points of view. To accomplish this I mailed letters of inquiry to Pacific Coast nurserymen so far as I could secure their addresses, stating to them the varieties of each fruit which had been approved by California planters, and asking them to mark them in the order in which they ranked in their trade and to add others which deserved mention. I received very gratifying response to this request, and the tables I present herewith show the result of a very voluminous correspondence. When the reports were taken up it clearly appeared that it would be of little use to consider the Pacific Coast as a whole, but to make lists for the different states, because varieties had such limited range in some cases. Of course the lists should not be made for states which are merely geographical divisions without regard for regional characteristics, but the attempt to group in regions of similar climatic conditions was impossible without taking more time than was available. It is also obvious that many nurserymen sell stock in all these regions and, therefore, a subsequent inquiry as to regional adaptations and demand is desirable. I hope to pursue that at another time.

The present showing is, therefore, valuable only in a general way and chiefly for the light it throws upon the trade in trees, although it will be found to have clear indications of important pomological inquiries to be subsequently taken up as to why certain varieties are high in one place and low in another. Some cases of this kind are easily explained, such as the precedence of American grapes over the vinifera varieties in the northern portions of the coast, but even these vinifera varieties have a place, because some localities favor them. A more puzzling proposition is the popularity of the Moorpark apricot at the north. This variety stands even lower in California than the tables indicate, because of shy bearing, but in some interior regions at the north it is said to be more trustworthy, which may be explained by climatic conditions which give it more definite periods of dormancy and growth. This is a matter which is as yet purely conjectural and needs to be inquired into. There are many other similar studies to be made of the behavior of varieties of all fruits, both from cultural and commercial points of view. All that I can do now is to thank the nurserymen who generously gave their time to the inquiry I undertook, and to present to them the preliminary results thereof which the tables embody.

APPLES.

California Growers.	*California Nurseries.*	*Oregon.*	*Washington*	*Utah and Idaho.*
Newtown Pippin	Newtown Pippin	Newtown Pippin	E. Spitzenberg	Gano
Bellefleur	Bellefleur	Jonathan	Newtown Pippin	Jonathan
W. W. Pearmain	Red Astracan	Gravenstein	Gravenstein	Rome Beauty
Gravenstein	W. W. Pearmain	E. Spitzenberg	Baldwin	Yel. Transparent
R. Astracan	Gravenstein	W. W. Pearmain	Jonathan	Ben Davis
R. I. Greening	R. I. Greening	Red Astracan	King	Winesap
E. Spitzenberg	Red June	Arkansas Black	Rome Beauty	W. W. Pearmain
Missouri Pippin	Jonathan	Rome Beauty	Oldenberg	Newtown Pippin
W. Astracan	E. Spitzenberg	Winesap	Yel. Transparent	Arkansas Black
Red June	Ben Davis	Wagner	Wealthy	Wealthy

APRICOTS.

Royal	Royal	Royal	Royal	Moorpark
Blenheim	Blenheim	Moorpark	Moorpark	Royal
Moorpark	Hemskirke	Tilton	Blenheim	Blenheim
Hemskirke	Tilton	Blenheim	Hemskirke	Hemskirke
Peach	Moorpark	Peach		Peach
Newcastle	Newcastle	Hemskirke		Acme
Tilton	Peach	Newcastle		

CHERRIES.

Royal Ann	Black Tartarian	Bing	Royal Ann	Royal Ann
Black Tartarian	Royal Ann	Lambert	Bing	May Duke
Black Republican	Bing	Royal Ann	Lambert	Early Richmond
Rockport	Black Republican	Purple Guigné	Black Tartarian	Black Tartarian
Bing	Early Richmond	May Duke	Black Republican	Black Republican
Chapman	Chapman	Black Tartarian	May Duke	Bing
Purple Guigné	Governor Wood	Black Republican	Early Richmond	Lambert
May Duke	Rockport	Governor Wood	Centennial	English Morello
Centennial	May Duke	Centennial	English Morello	Windsor
Black Bigarreau	Lambert	Chapman	Late Duke	Montmorency
Lambert	Knight's Early	Knight's Early	Governor Wood	Governor Wood

GRAPES.

Muscat	Muscat	Concord	Niagara	Concord
Tokay	Tokay	Delaware	Concord	Muscat
Cornichon	Cornichon	Niagara	Delaware	Tokay
Thompson	Emperor	Muscat	Moore's Early	Black Prince
Emperor	Malaga	Tokay	Muscat	Niagara
Malaga	Rose of Peru	Black Hamburg	Tokay	Black Hamburg
Rose of Peru	Sultana	Black Morocco	Malaga	Rose of Peru
Zinfandel	Zinfandel	Isabella	Rose of Peru	Sweet Water
Black Morocco	Mission	Campbell's Early	Sweet Water	Black Ferrara
Sweet Water	Thompson	Rose of Peru	Campbell's Early	Campbell's Early
Verdal	Black Morocco	Worden	Agawam	Delaware
Carignane	Mataro	Moore's Diamond	Black Hamburg	Rogers
Black Prince	Black Hamburg	Moore's Early	Moore's Diamond	Moore's Early
Alicante	Sweet Water	Agawam		Worden
Sultana	Black Prince	Black Prince		

PEARS.

Bartlett	Bartlett	Bartlett	Bartlett	Bartlett
Winter Nelis	Winter Nelis	D'Anjou	Winter Nelis	Seckel
Seckel	Seckel	Winter Nelis	Clapp's Favorite	Barry
Easter	Winter Bartlett	Flemish	B. Hardy	D'Anjou
Du Comice	Easter	Du Comice	Winter Bartlett	Winter Nelis
Coyenne D'Ete	Barry	Seckel	Seckel	Keiffer
Clapp's Favorite	Du Comice	Easter	Easter	Flemish
Glout Morceau	B. Hardy	Clapp's Favorite	Clairgeau	Easter
Barry	Madeline	Winter Bartlett	Flemish	Du Comice
Comet	Clapp's Favorite	Clairgeau	Keiffer	Clapp's Favorite

PEACHES.

California Growers.	*California Nurseries.*	*Oregon.*	*Washington.*	*Utah and Idaho.*
Muir	Muir	Elberta	Elberta	Elberta
Phillips	Phillips	Muir	Early Crawford	Foster
Salway	Tuskena	Salway	Muir	Early Crawford
Lovell	Lovell	Early Crawford	Phillips	Late Crawford
Early Crawford	Elberta	Late Crawford	Alexander	Orange Cling
Tuskena	Foster	Foster	Hales	Triumph
Foster	Early Crawford	Alexander	Triumph	Utah Orange
Elberta	Salway	Triumph	Foster	Globe
Late Crawford	Orange Cling	Susquehanna	Tuskena	Alexander
Orange Cling	Late Crawford	Phillips	Late Crawford	Muir
Susquehanna	Heath	Mary's Choice	Susquehanna	Salway
Nichols	Alexander	Heath	Sellers	Sellers
Sellers	Sellers	Wheatland	Heath	St. Johns
Lemon	Hales	Lovell	California Cling	Hale's Early
St. Johns	Susquehanna	Orange Cling	Briggs's May	Heath
Henrietta	Nichols	Lemon Cling	Charlotte	Wheatland
Mary's Choice	St. Johns	California Cling		Chair's Choice
Hales	Triumph	Globe		Carman
Alexander	Wheatland	Tuskena		Willett
Heath	Strawberry	St. Johns		China Cling

PLUMS.

Wickson	Wickson	Peach	Bradshaw	Hungarian
Hungarian	Burbank	Bradshaw	Peach	Yellow Egg
Kelsey	Hungarian	Green Gage	Hungarian	Satsuma
Yellow Egg	Kelsey	Cherry	Yellow Egg	Peach
Tragedy	Climax	Yellow Egg	Washington	Bradshaw
Washington	Green Gage	Burbank	Coe's Golden	Burbank
Satsuma	Yellow Egg	Coe's Golden	Burbank	Wickson
Burbank	Satsuma	Blue Damson	Green Gage	Jefferson
Jefferson	Tragedy	Hungarian	Columbia	Grand Duke
Climax	Blue Damson	Wickson	Climax	Coe's Golden
Grand Duke	Jefferson	Maynard	Duane	Blue Damson
Clyman	Washington	Washington		Green Gage

PRUNES.

French	French	Italian	Italian	Italian
Imperial	Sugar	French	French	German
Sugar	Imperial	Sugar	Sugar	Silver
Giant	Robe de Sergent	Silver	Silver	French
Robe de Sergent	Silver	Imperial	Imperial	Sugar
German	German	Giant	Giant	Giant
Silver	Italian	German	German	
Splendor	Giant	Splendor	Tennant	

VICE-PRESIDENT POWER. Up to the present address, we have not had any discussion, because the papers are of a strictly nursery proposition, and we intend to have a side meeting to-morrow where we can discuss our troubles; but this paper is of interest to all, both fruit-growers and nurserymen, and if there are any remarks or any questions, we would be pleased to have them now. If there are no questions, we will proceed with the next paper, "Introductions at the Plant Introduction Garden of Possible Interest to Nurserymen," by Prof. P. H. Dorsett. It gives me great pleasure to introduce Professor Dorsett to the audience.

INTRODUCTIONS AT THE PLANT INTRODUCTION GARDEN OF POSSIBLE INTEREST TO NURSERYMEN.

BY PROF. P. H. DORSETT, OF CHICO.

Since the location of the United States Plant Introduction Garden at Chico, California, in April, 1904, a vast amount of material in the form of seeds, bulbs, plants, scions, buds, and cuttings from this and other countries has been received and cared for. Quite a few of these, even in so short a time, give promise of commercial value. In the limited time that I am supposed to occupy with this paper I can but briefly discuss some of the more promising introductions that are of possible interest to nurserymen.

The Pistache.—Since the distribution last season of something over 16,000 seedlings, embracing varieties from Smyrna, Algeria, Sicily, Sahara, Syria, northern Syria, and southern France, we, as well as the officials at Washington, have received numerous inquiries concerning the trees, their fruit and their possibilities. Last spring we received scions and seeds of *Pistacia sinensis* from our explorer, Mr. Frank N. Meyer, which were collected by him in the Wei Tsan mountains near Peking, China. We will distribute this season between 16,000 and 20,000 young trees of the following varieties: *Pistacia vera, P. atlantica, P. mutica, P. terebinthus,* and *P. sinensis.* There are several other varieties that the officials at Washington are making every effort to secure and we hope to add these to our list by the end of another season. The distributions that have and will be made are being used in an experimental way by the Department officials as feelers, to determine the possible range of their successful growth. When this has been accomplished, the Department will assist those whose trees show promise of success in securing scions and buds of the best commercial varieties for budding and grafting on the young trees already established. Two and one half acres at the garden will be planted to varieties of pistache now on hand. This will be added to from time to time as other varieties are received. This planting will form a basis for scientific experimental work. Prof. S. C. Mason, formerly Horticulturist at the Kansas College and State Experiment Station, who is now with the Bureau of Plant Industry, will have immediate charge of this work, acting under instructions from Dr. Walter T. Swingle, in charge of Plant Life History. Dr. Swingle has devoted the greater part of six to eight years in studying the conditions of this industry abroad. He has now in course of preparation a bulletin dealing with this subject. In a recent conference with him in Washington relative to the success of this work at the garden, and its possibilities to the country, he spoke with enthusiasm and with the greatest confidence in the Department being able to establish this industry in the United States. (Samples of seed and a photograph shown.)

The Fig (*Ficus Species in Variety*).—This, though by no means a new introduction or industry, is receiving considerable attention at the hands of the Department officials. Our permanent plantings, after this season's work has been completed, will result in our having in the collection 127 named varieties, which will be added to from time to time. Efforts are now being made to secure specimens of a number of other varieties known to exist in far distant lands. Such a collection, under Government control and utilized by trained scientists, with no other object in view than the accumulation of knowledge and the improvement and production of varieties having commercial value, should result in great good to the industry. To-day fig culture is one of the infant industries of California, and our present knowledge relative thereto is more or less limited. This, however, surely can not long continue with a fruit so well adapted to the numerous wants of man. It is therefore reasonable to expect that, within a comparatively few years, this will be one of the most important horticultural industries of the State.

The Tung Shu (*Aleurites Sp.*), *or Wood Oil Tree.*—The wood oil tree, from the nuts of which the nut or wood oil of commerce is made, is a native of China, where, on account of its stately appearance, green smooth bark, large leaves, and spreading branches, it is styled the "National Tree of China." The seed from which the trees we have at the garden were grown, was sent us by Mr. L. S. Wilcox, at that time Consul-General at Hankow, China. The tree has a wide distribution in China, and will possibly succeed in sections of this country where there is sufficient moisture and the temperature does not go below 20° F. There appears to be several varieties of this tree. However, it is from the nuts of the Tung Shu that the greater portion of the exported oil is produced. In good soil with sufficient moisture the tree is reported to make ten feet of growth in a single season. Some of our trees made fully eight feet of growth the past season.

The trees are reported to begin bearing in from three to six years, and to continue in bearing for about ten years. The average yield of nuts is given as 20 to 50 pounds per tree, depending somewhat upon the location and treatment. The yield of oil is about forty per cent. The importations into the United States are annually increasing. "A good many thousands of barrels of this oil are annually being used by the varnish-makers of this country, and its consumption is on the increase."

The price ranges from 6½ to 10 cents a pound f. o. b. New York. The oil runs about 8 pounds to the gallon. The following letter from the O'Brien Varnish Company, of South Bend, Ind., bearing date of June 1, 1906, is of interest in this connection:

> We have your esteemed favor of the 26th ult. enclosing photograph of the wood oil trees that have progressed with you, and we are certainly pleased to have this photograph. We have not yet heard from our friend Mr. Clawson, in Cuba, as to how his plants did during the winter months, but we have no doubt that they went through as well as yours.
>
> We are interested to learn now if any one is figuring on growing these plants. We are prepared here to separate the oil from the nut, and should there be any one experimenting along these lines we should be glad to give him the benefit of our experience, or if you will allow yours to grow enough to produce nuts we will be glad to have some of these and will press some of the oil from them.
>
> Yours truly,
>
> THE O'BRIEN VARNISH CO.

It would seem that there is a possibility that this may develop into an American industry. (Photograph of seedling trees and samples of nuts shown.)

The Carob, or St. John's Bread (*Ceratonia siliqua*).—While this is by no means of recent introduction, it is a tree worthy of more careful thought and consideration, besides being one of our most handsome evergreen ornamentals. Its fruit is of considerable commercial importance as a stock food. The following extract from a letter of recent date, from Blanchford's Calf Meal Factory, located at Waukegan, Ill., addressed to Mr. David Fairchild, Agricultural Explorer in charge of Foreign Explorations, U. S. Department of Agriculture, is not only interesting, but illustrates to a certain extent the commercial possibilities of this as an industry:

> With reference to the commercial value of the pods, they are very fine for cattle feeding and for calf feeding, being very sweet and nutritious and much liked by all domestic animals. We can pay $40 per ton for the carob beans, f. o. b. Waukegan, Ill., in 50 or 100 ton lots. In this connection I would say that we shall have to establish a factory for our products on the Pacific Coast, as the freight rates there have been very high, although they have been slightly reduced lately, in which case, of course, there would not be very much freight from the grower to the factory, which most likely would be located at Portland, Seattle, or Tacoma, and they could come up there by boat from Los Angeles, San Diego, or Santa Barbara.

Dr. Franceschi, of Santa Barbara, states that the carob tree was introduced into southern California many years ago, and that specimens are to be seen in many places growing much more rapidly than in their native habitat, and that some of them are bearing very profusely. (Sample of carob meal shown.)

The Yang Taw (*Actinidia Sp.*).—These plants, referred to and discussed to some extent in my paper read at the thirtieth annual meeting of the California Fruit-Growers' Association, December, 1904, have made a fine growth and appear to be at home with us at Chico. However, the plants have not yet flowered and set fruit. We hope for these results the coming season. In addition to their possible value for producing a new commercial fruit, they give promise of being a fine ornamental vine. We have several hundred young plants on hand for distribution this season. (Samples of fruit and pot plant shown.)

The Olive.—We must all admit that the olive industry is not what it should be or what we should like to see in California. That mistakes in many of our earlier planted orchards were made, both in not planting suitable varieties to produce the desired results, and in planting in unsuitable locations, possibly can not be questioned. I feel, and I believe that the officials at Washington concur with me in this feeling, that there is a bright future ahead for the olive industry in California. We are now assembling at the garden specimen plants of the best varieties, preparatory to placing a specialist in charge of the work, to determine not only the best pickling and oil sorts, but also their adaptability to our soil and climatic conditions and, if necessary, secure new varieties by breeding and selection that will give us the desired results. One of the varieties recently received at the garden, and of which we are now engaged in getting up a stock of plants, deserves special mention. It is the *Chemlali* olive, "an old variety extensively grown around Sfax on the coast of southern Tunis, and is interesting as being probably the variety that is grown under the most arid conditions of any in the world." The trees are planted 80 feet apart, and after being established, are never irrigated, although the normal rainfall is only 6 to 10 inches. "This is the most conspicuous example of dry land agriculture applied to a tree crop of which we have any knowledge." The trees are reported to bear heavy crops of small fruit that is extremely rich in oil. (Photograph of orchard shown.)

The Original Peach (*Persica Sp.*).—Seed secured from a tree about 40 feet high in the German Legation grounds, at Peking, China, reported to be a beautiful ornamental. The seedling trees have done well with us, and in addition to its value as an ornamental, it may make a valuable stock. It might be used to advantage in breeding.

Sweet Kerneled Apricot, or So-called Chinese Almond (*Prunus Sp.*).—This is considered a fine little nut by the Chinese. They eat them salted, after soaking to remove the skin. The nut may have a commercial value with us and the seedling trees, which appear to be well adapted to our conditions at Chico, may prove valuable for stocks. (Kernels shown.)

The Bitter Kerneled Variety, or What is Known as the Second Quality.—This is said to be a special strain of apricot, only grown for its seed. Kernels of this importation were recently sent to Dr. R. H. True, Physiologist in Charge of Drug and Poisonous Plant Investigations, to be tested. In his reply to Mr. David Fairchild, bearing date of November 15, 1906, he says:

> Mr. Rabak, of this laboratory, has determined the prussic acid content of the apricot seeds, S. P. I. 17845, collected by Mr. Meyer in China. The crushed seeds were distilled into potassium hydrate or caustic potash solution as long as there was evidence that hydrocyanic acid was passing over. The test, made in duplicate, showed the presence of 5.509 per cent hydrocyanic acid. The bitter almonds yield about 0.25 per cent of hydrocyanic acid with one per cent of volatile oil. Although the use of apricot kernels as a source of hydrocyanic acid is a matter of current knowledge, still I find no citation of the per cent of this substance present in the literature available.

It is to be noted that these seed yielded 5.25+ per cent more hydrocyanic acid than the bitter almond. There is also a possibility that it may even exceed that of the commercial apricot pits, which within the past few years have come to be quite a source of revenue to the growers. Further experiments are necessary to determine the value of these introductions. (Kernels shown.)

Apple Scions (*Pyrus Sp.*).—These were secured at Shanghai, China. Mr. Meyer speaks of this introduction as "a greenish, white apple. The tree has an utterly different look from any apple I saw. May be a different species." These trees are too young to note any striking peculiarities at this time.

The White-barked Pine (*Pinus Sp.*).—Seed of this pine was received from Mr. Meyer, who secured them in the Wei Tsan mountains, near Peking, China. The tree is spoken of as a most beautiful pine, with silvery white bark, a slow grower, but extremely striking when old. The bark peels off in patches like the sycamore. The foliage is not as dense as in other pines. A fine tree for cemeteries and for dignified places. (Photograph shown.)

Thysanolaena agrostis.—This is an ornamental flowering cane, seed of which was secured in the garden of Poonah, India, by Mr. Barber Lathrop. This plant has done well with us and may prove a valuable addition to our list of ornamentals for the warmer parts of the United States. (Photograph shown.)

Globular-Headed Willow from China (*Salix Sp.*).—This is described as a remarkable willow, which forms naturally a dense, flat, globular head. "Extremely well fit to be planted as solitary specimens or in clumps in large grounds, where they can be observed from a distance, for at close range they are somewhat stiff in outline." These have made a good growth at the garden the past season. A nurseryman visiting the garden was attracted by the long slender limb growth of this, and suggested that with proper treatment it possibly would make a valuable tying willow. (Photographs of old trees shown.)

Time will not permit of my mentioning hundreds of other valuable introductions that we are growing at Chico. To-morrow Mr. Roland McKee will address the Fruit-Growers' Convention upon the immediate value of the Plant Introduction Garden to the State of California. Mr. McKee will deal more in detail with the work at the garden in general, our aims and desires. We are here, if possible, to aid and not to hinder legitimate private or public enterprises. We need and want your support and coöperation, and we extend to you one and all a most hearty invitation to visit the garden at any time to inspect our methods and the material we have on hand.

RESOLUTION RELATIVE TO PARIS GREEN.

PROF. C. W. WOODWORTH offered the following resolution referring to paris green, which was referred to the Committee on Resolutions:

> WHEREAS, The present law relative to paris green has resulted in a great improvement of the quality of this insecticide on the market in California, to the advantage of the fruit-growers of the State; and
>
> WHEREAS, This substance is becoming less important and the markets are being filled with lead arsenate and many other insecticides, for the control of which the present law makes no provision; and
>
> WHEREAS, The general fertilizer control law has proven very useful and acceptable to both grower and manufacturer; therefore, be it
>
> *Resolved*, That this joint convention of horticulturists, nurserymen and horticultural commissioners urge upon our Legislature the enactment of a general insecticide control law similar to that now operating for fertilizers, and in addition that they make provision for the scientific study of the nature and operation of the various insecticidal substances.

REPORT OF COMMITTEE ON GOVERNOR'S ADDRESS.

The committee having under consideration the Governor's address, here introduced the following report:

> We, your committee to whom was referred the Governor's able address in presenting the plan of taxation as approved by the Commission on Revenue and Taxation, do hereby make the following report:
>
> *Resolved*, That this State Convention of Fruit-Growers do hereby indorse the plan of taxation proposed by the Commission on Revenue and Taxation created by the last State Legislature, and we do hereby request the next State Legislature to take the necessary steps to put said plan in operation.
>
> JOHN TUOHY.
> JOHN MARKLEY.
> A. SBARBORO.

A MEMBER. I move the Convention accept the report of the Committee on Governor's Address, and pass the resolution.

MR. JOHN DORE. I wish to second that motion. The Governor has outlined a broad plan for a most radical change in the revenue laws of our State, and has given us the result of his study and investigation during his term of office.

Among the states he investigated was my former home, Wisconsin, which stands among the foremost. There they made an abstract of the revenue laws of the State and of other States, and they were able to tell us in an instant how much revenue was derived from the sale of beer; how much from the street railroads, and a few other things which I will not enumerate. This information was all systematized and tabulated so that in a moment the committee could give us the information as to the different States. The Governor had these things from which to draw his conclusions.

One word in regard to Wisconsin. In that State for many years there has been no tax upon the assessed property of the State for the purposes of State revenue. The entire expense of the Legislature and all departments of the State government and all the State institutions is collected largely from the public-service corporations. Not only this, but under the incessant and never-ending and tireless work of that matchless man, the Governor of that State, they have gone beyond the returns, so to speak, and have investigated the reports of the railway companies and insurance companies and other organizations that, under the law, were compelled to make sworn statements of their incomes, upon which they base their pro rata of tax or license for the support of the State government. They have found that those reports for a series of years were in truth much less than they should have been. They have gone back and collected large sums of money, reaching up to the millions, from the corporations in that country. And what else? They have in process of construction, or reconstruction, a new State capitol which will cost several millions of dollars, without one cent of tax upon the property of that State—the assessed property of that State—for that purpose. (Applause.) Not only this, but in the last campaign both the Republican and Democratic parties had in their platforms what they were going to do with the surplus money that was coming in from that source in that State. They decided that it should be used for the building of roads in the different counties of the State, and that the State would contribute some of this surplus money it had after doing all these things, after supporting the State institutions, and after the completion of the capitol, and after doing this work, for that purpose.

Now, the State platforms in that State mean something to-day. And why? Because they have a direct primary law, and under that law the members of the State Legislature, the candidates for the State Legislature and for the State offices, after they have been nominated through the direct primary, come together and form a convention, and that convention of that party, and of each party, makes the platform for that campaign and for that year in that State. Then they have to make good if they are elected. And both parties in their platforms this year have pledged to the people of that State an expenditure of a portion of this unexpended and unneeded money for the construction of highways.

I only mention these things to show what is being accomplished in one State under a state of finance similar to that which the Governor has recommended. The work of the commission for the last two years has been patterned on that system, and I say to you that the farmers and the fruit-growers and all the citizens of California will have a wondrous change in their system of taxation that will be very agreeable to us all if we will adopt this resolution. And not only that, but now and ever, until we get it, work for the reform outlined.

MR. JOHN TUOHY. As one of this committee, I thank Mr. Dore for his very forcible address. I think the matter should not go without discussion. If there is anything to be said upon the subject, I would like to hear it before this intelligent assembly. But the Governor, and the other members of the commission, have given it such careful consideration, and they have come to such reasonable conclusions, that we believe this Convention of Fruit-Growers, as it is entirely in their interests, is in duty bound to favor the new plan of taxation. I believe we can not pass it without some expression of our approval. I believe it will be a great mistake to do so. The commission has presented to California the means of adopting the most advanced revenue law in the United States. I indorse everything Mr. Dore has said. (Applause.)

MR. ARTHUR BRIGGS. I want also to second the motion, but I would like the gentleman who framed that to go a little farther with it. I don't like to make any amendment to it, but I think it should go farther. This paper presented by Governor Pardee is one full of information and should be used for education. (Applause.) I would like to have the framer of the resolution, or the one who offered the motion, to accompany it with a statement that this address of the Governor shall be put in pamphlet form so that every member of this Convention shall be able to draw on the Secretary of the Horticultural Commission for the number of copies that he would like to distribute throughout the State. I make that suggestion. (Applause.)

MR. JOHN MARKLEY. Mr. Chairman, I would like to state that the Commission on Revenue and Taxation is now publishing their plan. It will be published in pamphlet form by the State, and anybody that wants a copy of it can get it. That is one reason why we did not include in the resolution that it should be published. It would simply be making a second publication of the same thing.

SECRETARY ISAAC. Mr. Chairman, I will explain, for Mr. Briggs's edification, that the entire proceedings of this Convention will be published in book form immediately after the Convention, and everybody who is present will receive a copy of it, including the Governor's address.

MR. BRIGGS. I am perfectly aware of that; but that will be a cumbersome document, and to send out 10,000 of those through the State is not only cumbersome but expensive, and therefore I suggested that this be put in pamphlet form so that we could send them freely and generously whenever we were so disposed. I still hope that my suggestion will have weight, because I believe these should be distributed very much more generally than they will be distributed if we wait for the pamphlet published, as it has been suggested by the Secretary.

MR. JOHN MARKLEY. It will be published in a few days by the commission and ready for distribution—very much earlier than any pamphlet could be. The publication will cover all the ground.

MR. DORE. As a member of the committee, I most heartily approve of the suggestion that the Governor's address be published for the benefit of the fruit-growers of California. If it is in a pamphlet, it can be placed in the hands of the people of this State, and that may incline some of them to seek this larger document and graduate in this revenue system. But first we want them to take the condensed statement that the Governor gives. We want it placed in the hands of the voters of California to let them understand the question. Both parties are pledged to a direct primary law in California. If we get that, we have got the law, and we will be able to vote for the things we want.

MR. TALENT. I second the motion made by this gentleman to publish the Governor's address. I would be glad to see that go in as an amendment.

VICE-PRESIDENT POWER. I would like to know if that can be adopted in the report, or is an amendment necessary?

MR. BRIGGS. I have not made any amendment or motion.

MR. JOHN MARKLEY. Do you agree, Mr. Tuohy, that the Governor's address can be published?

MR. TUOHY. I do, for the reason that the report published by the commission would be voluminous. It would not be handy to distribute in the way Mr. Briggs desires to have it distributed, and I would like to see the address published by itself and distributed in that way. The State Board of Trade, of which Mr. Briggs is the President, should receive a large number, and I should like to see a large number of them in every part of the State.

MR. MARKLEY. It is agreed, then, that the report may be amended so that the Governor's address may be put before the people.

The motion was put on the adoption of the report of the committee, as amended, and was unanimously carried by a rising vote.

(At this time a recess was taken until 1:30 P. M.)

AFTERNOON SESSION—SECOND DAY.

WEDNESDAY, December 5, 1906.

The Convention was called to order at 1:30 o'clock P. M.

Vice-President Power in the chair.

VICE-PRESIDENT POWER. The program this afternoon has been changed a little by request. Mr. Roeding's paper, instead of coming second, will come at the end of the meeting, and I understand Mr. Kellogg and Mr. Stabler have neither of them sent their papers, and if we have time we may have Mr. Pease's paper this afternoon in place of this evening.

SECRETARY ISAAC. I have a telegram from Mr. Stabler, who is on the program, and he says he wishes to send his regrets, as it is impossible for him to attend the Convention at Hanford this week.

VICE-PRESIDENT POWER. The first paper we will have this afternoon is "The Relation of the Nurseryman to the Grower," by A. N. Judd, of Watsonville.

RELATION OF THE NURSERYMAN TO THE GROWER.

BY A. N. JUDD, OF WATSONVILLE.

Probably no two interests should be so interwoven and friendly as fruit-growing and the nursery business, yet, strange to say, the intercourse between the orchardist and the nurseryman is of but a few days and of a perfunctory nature. The embryo orchardist is usually an enterprising and progressive farmer, who has no knowledge whatever of pomology, but who remembers something of the taste he had, when a boy, for the Greening, the Newtown Pippin, and the Blue Damson. His interrogatories put to the nurseryman regarding best varieties to plant, considering the climate and market, disclose the fact that he has no positive knowledge on the subject. In looking through the nurseryman's stock, which seems to be on dress parade, so even in height and straight are the rows, the purchaser will see little white boards, partitioning off the plot or field, with supposed names of varieties, in plain and legible letters, standing as a guarantee that what is bought is true to name. He will see men cutting off a few of the lower limbs of each young tree, these cuttings to be placed in damp sand to be used as stocks for root grafts, which reproduce like variety; if, later, they are used for budding, the results are the same. The buyer may often notice on roots of young trees that have been dug preparatory to heeling in, or for a customer, a white or moldy substance, and on some of the limbs a pimply effect. But the prospective orchardist is not an entomologist, so he waits awhile, a few years perhaps, before he begins to take notice that his young trees are uneven, both in thrift and size; with some there seems to be swelling at the ground, and the excrescence is covered with what seems to be mildew. He then consults his neighbor, who knows as little, or perhaps less, about entomology than he does. After considerable discussion they decide it is due to lice of some kind, and those Newtown Pippins that are doing so poorly, that are making no growth, and actually going back, are voted by the nurseryman as not suitable to the climate or soil. In digging them out you notice, when the limbs are cut, that they are dry, and under the bark they have a streaky, red look; and yet what puzzles him greatly is that a few of the trees of the same variety do exceedingly well; in fact, you will find this condition over all your orchard on those trees that have none of the ailments mentioned. This is often accounted for by the nurseryman as your own fault, the result of improper cultivation or pruning. You reason that he ought to know, and I ask right here, should he not? When I look over the live-stock field I see a struggle for the best strains of the best breeds which make the best crosses, and no price too high and no distance too great to accomplish the result aimed at, which is to get the very best of each—strong, and fertile, and above all unmixed. But did you ever see a nurseryman around any orchards, during fruiting season, noting or marking trees of special strength or merit with a view to securing scions from the best types of true varieties, for the purpose of improving his stock? Do the nurserymen agree even on the names of varieties and what they are? To illustrate: A buyer in the community in which I live had a lawsuit to recover the price of a car of Winesaps in California, but which were not the Winesaps the purchaser had known when he lived in the East. Now, as I have two varieties of Winesaps, and at least two varieties of Newtown Pippins, the question arises which is which? And like conditions exist with other varieties, causing no end of trouble in the market. It seems to me that each State university should establish a chair in pomology, and, where possible, there should be State nurseries, or at least a strict supervision of the plant industry, so that the responsibility for filling up the land with all kinds of rubbish, pests, and diseases could be placed, and damages recovered. No stock-breeder dare sell you stock with anthrax, tuberculosis, glanders, or with any other contagious disease; yet many nurserymen can, and do, sell you, every year, wholly or partially diseased trees. Such trees are taken from ground that is often alive with woolly-aphis and other pests; the trees often come to hand dead or in a dying condition, caused by the use of deadly gases to partially destroy the pests, leaving only sufficient life to permit the trees to eke out a miserable existence, at great loss to the grower. I would enact a law which places a fine for selling unclean trees or those not true to name; this fine I would make equal to the cost of the tree sold, the cost of cultivation, the rent of land, damage to the land for like product (as no apple will grow where one grew before), and the loss of profit that should accrue during the time before the discovery of the criminal mistake was made. It seems to me that the longer the average nurseryman is in the business the less interest he takes in the betterment of our fruits, and the more certain he is to combat discoveries, or I might say rediscoveries, which the energetic orchardist makes by reading up or by experiment. However, there was a time when he had pride in the betterment of fruits and was looked up to as an encyclopedia on all subjects pertaining to horticulture; but I am sorry to say that now, with few exceptions, we refer to books of fifty or more years ago on that all-absorbing question of fruit-growing. I notice, so far as I have read, that these works are specific on the subject of where on the trees you should select your grafts, their proper condition, and in what stock you should put them, but in no instance are the methods of our nurserymen recommended; in fact, the more you read these works the greater is your surprise and shame, for, with the exception of a few minor details where new pests are concerned, we have actually gone back, apparently forgetting (if we ever knew) that the horticultural knowledge of the old Greeks, Romans, Frenchmen, and Germans, as well as of our own Downing, was not hereditary. It is true we have our Burbank, our Coates, and our Roeding, not in the same class, however, but each in his way has done things, and in these days of selfish commercialism their acts stand out as a star, giving some light in that dark corner of horticulture, the nursery business.

VICE-PRESIDENT POWER. You have heard the reading of this paper. Is there any discussion or questions?

MR. DARGET. I am an orchardist at present, and I would like to emphasize some points of this paper, and emphasize them not alone for the protection of the orchardist, but for the protection of the nurseryman as well. In order that this may be fairly seen, I want to give an illustration of what occurred in an orchard which I bought a few years ago. At that time I knew absolutely nothing about horticulture. In a tract of eight hundred acres which I purchased, most of it was in very good condition and true to name; but there was one particular block of six acres of peaches which looked to me like a good thrifty orchard. I will say that I cut the orchard up into ten-acre lots and sold a good deal of it before the crop matured. When the crop matured on this six acres, I found a great surprise in store, both for myself and for the man who purchased it. Upon investigation, I learned that Mr. Richard Adams, who is my superintendent, and who was there and planted that orchard seventeen years ago, with the superintendent for W. R. Strong Nursery Co., from Sacramento, had ordered a carload of early Foster peaches from an Eastern nursery to plant this six acres. The car came and they planted the trees, and the remarkable thing about it is, perhaps, that there was not an early Foster tree in the whole carload. Not only that, but there are growing on that six acres to-day, as the result of that planting, seventeen different kinds of peaches, ripening anywhere from the early Alexanders, the 8th or 10th of June, to the Salways, the latter part of October. For commercial purposes that block of ground is practically useless. If a man lived on that ten acres and could take care of the work himself, he would not need to hire anybody to help him take care of those peaches, because he could take care of them and have time left to visit his neighbors; but as a commercial proposition, handled with a large block of orchard, it would occupy too much time and keep the superintendent watching that orchard to know just when to send somebody to pick the peaches, to make any possible profit from it.

MR. B. E. HUTCHINSON. I would like to ask a question of these nurserymen, and I would like to get an answer to it. I have many times had to reset some trees, and have bought the same kind, sometimes of the same nurseryman, to plant in place of the others. For twenty years now I have planted a few trees every year to replace those that were lost, and I have never yet got a tree to replant that was the variety that I ordered. If I ordered Bermudas, I would get Crawfords, and if I wanted Crawfords, I would get some kind of cling peaches. Now, I want to know if that is the way they intend to treat us? And how could it happen that for over ten years I have replanted trees, and I have never yet got one that was of the same variety that I ordered? I want to know if you keep a batch outside there to give a fellow after he has had the misfortune to lose his trees, and say, "Why, it is all dead loss to us anyway," and pass them over? I have always been willing to pay for my trees. Sometimes I have done it and sometimes I have not. Through carelessness on their part, I have said no, and I have a case now where I have refused to pay for trees and I am not going to pay for them.

MR. BOWERS. I have taken a great deal of interest in the growth of trees, especially prunes. Prunes are my hobby, and I will stay by the prune industry through thick and thin. My first work was budding in a nursery, and at that time they had a gentleman who had charge of the nursery who I thought knew very little about his business. Of course, I said something about some things, and I was told I had better attend to my own business. The point I wish to bring out is this: that superintendent had cut the wood off the branches of his young trees, and during the six years that I was on that ranch there were trees growing in that nursery probably eight or ten generations removed from the original parent tree. Now, all over the State wherever I have visited and talked to the prune men, I found this condition. In any orchard there will be four or five trees that will bear large prunes, and then you will come to a tree with small ones. I think the parent being so far removed from the bearing tree has a great deal to do with it. When I was quite a boy, we had an orchard with, I think, thirty trees in it. Whenever they commenced to bear, the one that bore the largest fruit was the one we grafted from. We grafted one third of them one year, one third the next year, and the other third the third year. Those trees developed into fine trees, and I think it was because they were grafted from the trees that bore the best fruit.

MR. A. J. JEFFRIES. All my early life was spent in the nursery business back in Illinois, although for twenty years I have not had anything to do with the business. Now, being one of the Horticultural Commissioners of the State, and supposedly in opposition to the nurserymen, I would not like the impression to go out from what these gentlemen say here that that is the condition all over the State. I know one section of trees in southern California where I believe every tree in that section is true to name. I know an apple orchard within five or ten minutes' ride of the City of Los Angeles where every tree is true to name, and it is not fair to our nurserymen to take up individual samples, which no doubt are true, and make a principle from them. I have a great deal to criticise in relation to the nursery business, but I don't like that impression to go out as an expression of this meeting. There are thousands of acres where every tree is true to name. We have within half a mile of where I live navel orange orchards fifteen years of age, where every tree is true to name, and if you get a navel orange tree true to name, you know the nurseryman is all right.

MR. CASH BLOWERS. I wish I could second the remarks of the last gentleman, but I can not. I have bought of different nurserymen; I have bought of home nurseries, and I have bought of nurseries abroad; and I have come to the conclusion it don't make any difference where you buy, you get mixed trees anyway. I have bought trees for thirty years, and I have got my first lot of trees to buy that were all true to name. I have bought some that were much better than others, but I believe that the nurserymen with whom I have had the misfortune to deal, were, as a general thing, careless. I don't believe they do those things intentionally, as a general thing. I believe one year they did it intentionally. That is the year the trees came from the East. I bought about three varieties of trees, as I supposed, and I got fifteen or twenty. There is one thing very peculiar about it. I got three varieties, and out of those I got some of what purported to be the variety, but in each case they were not just the same peach as we grow in California. There was enough difference so that you could see it. The Orange Cling was different, and the Salway was different; also another variety that I have. I discarded it once, but it was different from a California peach.

MR. THISSELL. I have had a limited experience in the fruit business and also in the nursery line. The trouble does not lie altogether with the nurserymen. There are a great many honest nurserymen. I don't like to see them criticised too heavily. The trouble lies with the growers—the men who raise the fruit. There are a great many nurserymen who send out to men who have had long experience in the fruit business to get their scions to graft and their buds. The orchardists are careless in giving this stock to the nurserymen. They often order a Chinaman or a Jap to go out and cut these scions. These men cut them from the first tree, regardless of what the conditions of that tree are. The nurseryman sends to good, reliable men and he grafts the trees from the stock he gets from them. He puts them on the market, and the consequence is when they are grown up they are not what he got them for. There is where the trouble lies with the nurserymen.

MR. HUTCHINSON. I will answer that by saying that we never do that work for the nurserymen. The nurserymen come and cut their own. I have some trees on my place, about four thousand, Lovells, Elbertas, and the Phillips Cling, and many of the nurserymen come there to get their buds. I have said to them that I bought these trees of a certain nurseryman and I know they are all right; but to my horror last year when they began to bear I found in the Phillips Cling that some of them were Orange Clings. We never sell buds or scions there. The nurserymen come there and cut them themselves. The nurserymen of our county have got down on their books the different trees that I have on my place and where they can get them, and where they are mixed they are marked out.

MR. NEWELL. I will not take up much time. There is always two sides to a question. I am an honorary member of the Nurserymen's Association. I have never sold a tree in my life and never expect to, but I am connected with the State Board of Horticulture of Oregon. I want to say in justice to the nurserymen that I do not believe we have a better class of business men in the State of Oregon—who take more pains to deliver good goods than they. If you buy goods from a groceryman, every once in awhile you will get what you do not order. You will get things from the manufacturer that are not true to name. Do not be any harder on the nurserymen than on other people. Consider that they have the hardest business in the world to deliver goods absolutely true to name. California fruit-growers, don't you believe the nurseryman is dealing just as honestly by you as you are by the public when you ship green oranges to market or green grapes? Let us be charitable to the nurserymen and have justice on both sides. (Applause.)

MR. JUDD. Evidently there has been a wrong construction put on that paper. There is not a line in that paper that sets up any dishonesty on the part of any nurseryman, but it is simply a matter of carelessness, a matter of actual lack of knowledge of their business. It is not criminal. It may be dishonest, but not in the sense that we look at criminality or dishonesty. Allow me to say right here that the prime object of that paper was to get unanimity on the subject of variety. I suggested that we have a chair of pomology in the universities. I do not want the impression to go out that I accuse the nurserymen of dishonesty.

MR. ROEDING. The nurserymen expect to cut buds as far as possible from bearing trees, and in most cases we do it. My friend, Mr. Hutchinson, spoke about not being in condition to get fruit true to name. I think I have heard Mr. Hutchinson on many occasions say he had been treated well by the nurserymen. In spite of all the caution nurserymen use, there are chances of making a mistake. I want to make an illustration of Mr. Hutchinson. Probably his trees have been untrue to name. I don't think there is a nurseryman in the United States who has not sold trees untrue to name. I have gone to Mr. Hutchinson to cut buds, and he has told me that such and such trees were true, that there was not a mixture in them; but nevertheless there was. It is very rarely that a nurseryman can take the word of an orchardist as to his trees being true to name, because orchardists do not go into these things as thoroughly as nurserymen do. In my experience with Mr. Hutchinson, we have gone through his orchard, and although some trees would be untrue, we found trees here and there that were not untrue. There are times when mistakes will happen in spite of all caution, but I think, as a rule, nurserymen find their stock is true. When you bear in mind the number of men employed in nurseries, and the readiness with which mistakes are made, you will not wonder that these things do happen. If you have a man in your employ in charge of a certain variety, that man may have it in for you. He mixes up the varieties. How is the nurseryman going to discover it? A nurseryman sells trees that he thinks are true, and some of them are untrue in spite of all the caution he can take.

MR. McGILL. There is one point to which I would like to draw attention, and that is, if they would be willing to pay the nurseryman a sufficient price for his trees so he could employ enough capable men to look after the details for him, they probably would get better results; but if John Smith is selling trees for 10 cents, and Mr. Roeding is selling a much better tree and he asks 3 or 4 cents more for it, they will go to John Smith every time—nine out of ten would, anyway. That is our experience.

MR. SPRAGUE. I have been listening to this discussion with much interest, because I expect to buy some trees before long and I am pretty badly scared now. But I want to know if the least we should ask from the nurserymen is, that they should go to the trees when they are bearing and mark those trees from which they expect to get their scions, and in that way be sure of accurate information in the first place? That is one thing we should ask them to do—not hire men, but go themselves and mark those trees and keep them straight as far as possible. There is a chance, I can see, for things going wrong; but because they are so overwhelmingly wrong, it seems to me we can not let up one bit of the pressure on our friends, the nurserymen, in demanding the greatest possible care so there will be no mistake.

MR. HUTCHINSON. There is one thing I want to say. When the nurserymen come to their buds, they should know they are right. Some nurserymen are very careless, I know. I showed one nurseryman years ago an orchard where he could get some buds such as he wanted. He wanted Crawfords. I told him to go ten rows to the east and all of them were Crawfords, and I thought that would be best for him. When I came up at noon, or about noon, he was cutting straight through on two rows of trees, and he had gone through five rows of Salways, five rows of Lemon Clings, and into a mixture of nectarines. I told him that his buds were worthless and that he had better throw them away. He didn't throw them away; and I have never bought anything of that man since. Since that, there have been a good many buds cut on my place that are going to make some trouble, because I had all the confidence in the world that they were true to name, and I sent the nurserymen in there to cut; and to my horror, when they came to bear last year, I found there were fifty trees in that lot that were not true to name, and any one who cuts buds there will have trouble, the same as I have had. I will say that I went through and tied a half-inch rope on every one of those trees that I could find, and I told every nurseryman that came there not to cut from those trees.

VICE-PRESIDENT POWER. Ladies and gentlemen, I don't wish to cut off discussion, but there are several other important papers and we have spent over an hour on this. There are other papers which must be read this afternoon, because the entire program is long. We will now pass to "The Need of a National Inspection Law," by A. Eckert.

THE NEED OF A NATIONAL INSPECTION LAW, AND HOW TO SECURE IT.

By A. ECKERT, of Detroit, Wash.

Mr. President and Gentlemen: When our worthy secretary requested me to prepare a paper on this subject I was sure he had made a bad selection, and, as I wrote him, I would sit on the fence until able to decide which way to jump. The question seemed so great; had been written upon by our greatest experts, men thoroughly familiar with its every detail, urging the necessity of such a law. Also the long labors of the committee on law and legislation of the American Association of Nurserymen, ending in failure and, I fear, disgust at the selfishness of some, the indifference of others, and the opposition of many.

The need of such a measure is self-evident to the most casual observer or one but little familiar with the conditions surrounding, not only the nurserymen, but the fruit-grower, farmer, market gardener, and even the lumberman, as many injurious insects seriously affecting one or the other are all distributed by the same process. But the ones most interested and whose interests are identical are the nurserymen and the horticulturists or fruit-growers, and strangely enough these two seldom work in harmony with each other. Yet most nurserymen are, in a manner, also fruit-growers, and are or should be familiar with the stand taken by the general fruit-grower against the nurserymen.

The fruit-grower wants the trees he buys free from insect pests and disease and blames the nurserymen if they are not; at the same time but few make any attempt to clean their orchards or prevent the spread of pests and diseases. The nurseryman, in his effort to supply the fruit-grower with the clean, healthy trees demanded, insists that the fruit-grower should be compelled to take proper precaution to keep his orchard clean and healthy, as orchard and nursery are often in close proximity, to enable him to have his nursery in condition to supply the quality of goods demanded.

Then again, the fruit-grower objects to any law prohibiting him from selling his wormy fruit in any city or State, as evidenced by a horticultural writer in a paper read last January before the Washington State Horticultural Association claiming that every orchard in the two counties mentioned was infested with the codling-moth. (He does not travel much in those counties or he would not make that statement.) Again, a conscientious inspector in one of Washington's counties is sued for damages because he prevented the shipment of a car of wormy apples to another State. Under national inspection no such attempt would be made. Now, as for the nurseryman who does an interstate business, and nearly all come under that head, what are his difficulties?

Just a small notice in many catalogs explains this; it reads, "*We have complied with all inspection laws and have all official tags and licenses and ship in every state and territory.*" Well, if he has, he has done wonders; he has got his different colored tags and paid licenses from $2.50 to $25 per annum, as well as paying the licenses of every salesman he employs.

Not only are there State laws, but counties as well that try their hand at regulating the nursery business, all of which adds greatly to the happiness (?) of the nurserymen. In our own experience with the county inspectors we have found them conscientious and gentlemanly, endeavoring to do their work to the best of their ability, but as State officials they do not command the respect or compel the observance of the law as they would if their power originated in the Agricultural Department at Washington, D. C.

Had our Government taken precautions to prevent the introduction of dangerous insect pests, very little if any State legislation would have been done. Nearly all of the most dangerous pests we are afflicted with are imported. Had there been a trained entomologist at the custom house at San Francisco to detect and prevent the introduction of the San José scale, State laws and regulations would be rare, if any. The spread of this one insect, though hundreds of other kinds had been imported before it, was so rapid and its devastation so great, causing the greatest alarm in nearly every fruit-growing State, that State after State passed laws, good and bad, causing the greatest confusion to the nurserymen. When the cotton-growing states passed too stringent and unreasonable laws against the State of Texas on account of the boll weevil, the Government took a hand in the matter and by its advice and action brought the states to reason. May we not hope for the same in our behalf?

The greatest objection to a national law has been the invasion of State rights. I want to say right here that many of you will live to see that question put rightfully to sleep. Ours is a nation; no longer a confederation of states. Uncle Sam has arrived at that age where he is entitled to wear trousers that come to his shoes. Those states that formerly proclaimed State rights as a cardinal doctrine are at present praying and petitioning the Government to assume control of their maritime hospitals and many other matters.

The Government has demonstrated its authority in the matter of horse and cattle inspection, prohibiting their movement, not only from one State to another, but from one county to another in the same State; making regulations for the inspection and certification of cattle from infected districts and cleaning and disinfecting cars.

It is working harmoniously in coöperation with the states under a national game law known as the Lacey Act. Under the Lacey Act the

Agricultural Department has men at the custom houses for the inspection of birds and mammals which can only be admitted by special permit from the Secretary of Agriculture. This should be taken advantage of: as we now have national inspection of birds and mammals, why not one for the protection of the lumber interests, the agriculturist, and the horticulturist? Prof. T. S. Palmer, of the Agricultural Department, says of the Lacey Act: "When the law went into effect it was thought by some that it would be impossible to enforce its provisions, that the requirements of permits would cause serious delays, loss and endless criticism, that the placing of the work under two departments would result in friction (the customs being in charge of the Treasury Department and the inspection under the Agricultural Department) and prevent the accomplishment of the desired object." Experience has proven such fears were groundless; permits are obtained in advance, or upon arrival a telegraphic request for inspection or release usually secures such an order.

To show what has been done: In the Year Book for 1897, Prof. L. O. Howard presents the danger of importing insect pests in a strong manner. Quoting from his article: "In the spring of 1897 a convention of the representatives of the horticultural and agricultural societies of many states was held at Washington, D. C. This convention was called to consider the desirability of National and State legislation with a view to preventing the introduction and spread of injurious insect pests and fungous diseases. This fact is mentioned as indicating that at last the persons most interested understand the situation and are seeking a remedy. We need only look at the already long list of injurious insects to become at once aware of the fact that had a national quarantine been established long ago its saving to the country would have been enormous. Japan has a number of injurious insects which have not yet reached us and against which we must be on our guard. Fortunately Japan is one of the most enterprising of nations and has encouraged the study of entomology. The pests are brought to us as unnoticed or ignored passengers on or in their natural food such as nursery stock, plants, fresh and dried fruits, clothes, lumber, animals, and straw or packing material. The commerce in nursery stock and living plants is rapidly increasing; the Government entomologists are familiar with nearly every injurious insect in all nations and would know at once what to look for in any importation from any country."

That our country occupies first rank in applied economic entomology is conceded. In 1896 the French authority, Dr. Paul Marechal, writing on the subject of applied entomology, began his paper with the words, "There exists nowhere an organization dealing with applied entomology capable of rivaling that of the United States." While the State of California has long been alive to this question, maintaining a quarantine system which has been very effective as against insects occurring upon importations consigned to persons within the State, she has not been able to protect the country at large or to take action upon any importations at her ports when consigned to persons of another State.

Mexico has many pests that have not yet gained a foothold in our country, but with the rapidly increasing travel and the importations of fruits and merchandise, it can be but a short time before we shall have them wherever the climate is congenial. The same with China, Japan, or any other country. Australia has several very destructive insects, unlike anything in the United States, which, if imported, would prove disastrous to certain fruit-growing interests. One of these, the apple-beetle, attacks the apple and bids fair, in portions of Australia, to rival the codling-moth in its damage.

Quoting further from Professor Howard, he says: "It has been shown that the majority of our most injurious insects have been imported; it has also been shown that there are many other injurious insects in foreign countries which are noted enemies of cultivated crops and are liable to be brought over under our present lack of inspection laws." Laws must be passed establishing a system of inspection of dangerous classes of merchandise, just as has already been done in the case of live stock.

I wish, also, to call your attention to a most interesting and able article on this subject, appearing in the May number of the *Popular Science Monthly*, by Prof. E. Dwight Sanderson of the New Hampshire College.

I have quoted freely from Professor Howard to show you that the national Department of Agriculture is fully alive to our present needs; that something must be done to protect the country from the injurious insect not yet with us and to bring order out of the chaos now existing as a result of the many different and ofttimes unreasonable State laws. I believe that if the nurserymen, acting] in coöperation with the National Pomological Society and the Agricultural Department at Washington, could agree upon some line of action it would not be a difficult matter to get the desired relief from Congress.

STATE AGRICULTURAL EXPERIMENT STATION,
PULLMAN, WASH., August 13, 1906.

MR. ECKERT, *Detroit, Wash.*

MY DEAR MR. ECKERT: Replying to your favor of August 8th allow me to say that I think that a national inspection law for nursery stock is not only practicable but desirable. The recent movement in national affairs is to enlarge the powers of the Government so far as inspection and oversight are concerned. The Acts of the recent Congress show that this is fully recognized; the meat inspection law is a good illustration. As nursery stock is largely shipped from one State to another, it is possible to include such an inspection under the duties of the Interstate Commerce Commission. Of course such inspection will only affect stock that can be shipped from one State to another. I do not think that the matter has ever been taken up in Congress, and I suspect that it would meet with determined opposition from many sources. It would not benefit a local producer, but it would certainly give great protection to the buyers of nursery stock. I think it would be easy to enlist the support of the various State Horticultural Associations and think that the matter should be handled through these agencies.

I thank you very much for the suggestion and believe it would be well to bring the matter up before our next horticultural meeting.

Very truly yours,

E. E. ELLIOTT.

OREGON STATE BOARD OF HORTICULTURE,
GASTON, OR., August 15, 1906.

MR. A. ECKERT, *Detroit, Wash.*

DEAR SIR: Yes, I think a national law for inspection of stock practical. It should of course provide uniform regulations for every one, and I believe the vital point of that will be to require all nursery stock, whether injured or not, to be dipped in a solution of lime, sulphur and salt, before placing on the market. This will be better than the gas treatment and will be visible. An inspector will know then that the stock has been treated, and such treatment will be beneficial to any stock and injurious to none. The root troubles would of course escape, as they do now; but I find very few trees that have any serious root trouble that do not show it in their general appearance in the nursery. I think that part could be left safely to local inspection.

Very truly yours,

W. K. NEWELL.

IOWA STATE AGRICULTURAL AND INDUSTRIAL LEAGUE,
DES MOINES, September 10, 1906.

A. ECKERT, *Detroit, Wash.*

DEAR SIR: Your favor of the 8th to our Professor Beach has been by him placed in my hands, because since the first discussion relative to Federal inspection I have been chairman of the legislative committee of the American Association of Nurserymen, which has had the whole matter in charge.

The present condition of the attempt to secure Federal legislation is that several of the states refuse to go forward further with the work, saying they had good enough State laws and would prefer not to have a Federal law. The trouble about the matter is that while the Federal Constitution provides that Congress may make all needful rules and regulations relating to interstate commerce, it does not take from the states what are known as police powers, and under these police powers the State may examine anything coming into its borders from another State, if there is reasonable ground to fear that the import may be dangerous to the life, health, or property of its citizens. The authority of Congress to say what may not go out of any State or Territory into national commerce is unlimited, but when it comes to say what may go into a State it is restricted to those articles which, as found in commerce, are not dangerous to the people or their property. Whisky has been held to be merchantable because while barreled up or in any original package it never demoralizes any one. Nursery stock with disease or insect pests might possibly spread infection even from a box or bale; wherefore, a State may examine it.

Just what we shall be able to do in the future I am sorry that I can not say, for nobody knows. If we can all agree upon what we desire, then the next thing to do is to draft an act embodying our desires, and send a committee to Congress, presenting our case to the Committee on Agriculture. If that committee thinks about it as we do, there would be a good prospect of getting the bill enacted into a law.

Very truly yours,

C. L. WATROUS.

UNITED STATES DEPARTMENT OF AGRICULTURE, BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C., September 17, 1906.

MR. A. ECKERT, *Detroit, Wash.*

DEAR SIR: Noting again your favor of August 8th, the receipt of which I acknowledged from Enid, Okla., on August 21st, I would say, further, that the National Association of Nurserymen has been making efforts for several years, through a committee appointed for the purpose, in the direction of a Federal inspection law for nursery stock. The gentlemen whose names I mentioned, I believe, in my letter of August 21st, Col. C. L. Watrous, Des Moines, Iowa, and Mr. Silas Wilson, Atlantic, Iowa, are members of this committee and they have been here in Washington several times in the interests of a Federal inspection law. Just how far the matter has been carried I am not able to earn. I am under the impression, however, that the nurserymen, viewing the matter from one standpoint, and the fruit-growers and horticultural inspectors, looking at it from still other points of view, have never been able to agree sufficiently well upon the requirements of such a law, hence you can readily understand some of the obstacles which must be overcome before any satisfactory legislation is possible. This, in a measure, answers several of your questions so far as it is possible for me to answer them.

Then again, conditions in the different parts of the country, both in regard to the nursery interests and to the fruit-growers' interests, are so diverse that it is almost a question in my mind if it is possible to formulate any law which will be flexible enough to meet all those conditions and still not be so flexible that it will be of no real value. On the other hand, the laws now applying to the sale and transportation of nursery stocks are so different in the different states that annoyance, delay, and losses frequently occur, or have in the past.

As to what the provisions of a Federal law relative to the handling of nursery stock should be, I do not feel capable of expressing an opinion, and for that matter, am not lawyer enough to know where State rights leave off and Federal authority would begin in such a case. Hence it will be better for me not to attempt to define what provisions should be made in the terms of such a law.

If any Federal law is ever passed, it seems to me probable that it will come as the result of joint action of the fruit-growers and the nurserymen. As above stated, the National Association of Nurserymen has been considering the matter for several years. The American Pomological Society is probably as representative a body of fruit-growers as there is, and though this society has not usually attempted to influence matters of legislation, it would seem to me to be, logically, the proper body of fruit-growers to take up this matter. I am not sure what the attitude of the Horticultural Inspectors' Organization is in regard to this matter. I would suggest, if you wish to take it up, that you write to Mr. G. G. Atwood, Capitol Building, Albany, N. Y., for information. I do not know if he is an officer in the Inspectors' Association, but am quite sure he could give you full information.

To learn definitely just what has been done and how matters now stand, you can not do better than write to either Col. Watrous or Mr. Wilson—or perhaps to both—who, I am sure, can give you more information than any one else whom I know.

I very much regret that so long a delay has occurred in my final answer to your letter, but I returned to Washington only a day or two ago and this is my first opportunity to attend to it. I hope the delay has not been a matter of serious consequence.

Very truly yours,

H. P. GOULD,
Assistant Pomologist.

MR. ECKERT. I want to say that yesterday I had the pleasure of meeting your State Quarantine Officer. I was convinced that he was a man whose heart was so full of the true Western spirit that if he met a man who was unfortunate he could not help doing all he could to assist him. He cited two instances: one, nine hundred boxes of lemons which came to the coast, and he would not permit them to enter, though out of sympathy for the man he told him to enter them at Portland. The man said he could not. "Go to Vancouver." "No use; can't get in there." "Go to Seattle." "No use; can't get in there." "Well," he says, "send them to Chicago." He sent them to Chicago and sold them. Now, that is very much like carefully guarding your front door, but if you step around to the back door it is wide open. What are you going to do there? You have got six or eight transcontinental roads running to the coast, trains running in sections, bringing thousands of people. Suppose they bring some of those lemons here, how are you going to protect them? They consume the lemons and throw them out of the car window, and how are you going to stop it? If you have got a national inspector, or if your quarantine officer had his appointment from the National Government in connection with the State Government, it would be better. We don't ask for any modification of your State laws, but if he could take that fruit and condemn it and destroy it and not give it a chance to get into your back door, then you might be reasonably safe.

Another case cited is a lot of peach trees which came in bearing the certificate of the State Inspector. When he got hold of them he found they were infested with root-borer. If that inspector had his appointment from the Government, you would be reasonably safe.

VICE-PRESIDENT POWER. You have heard the reading of the paper. It is now open for discussion.

MR. EHRHORN. As I am the party who condemned those nine hundred boxes of lemons, I want it understood that there was nothing sympathetic on my part that helped that fellow out. I just looked up the law of the State, and those lemons were shipped out of California. It is unfortunate that our law does not protect us a little better in certain ways. Our appropriation is so small that we can not station inspectors on the boundary lines between other states. Some day probably we will do so, but these lemons arriving at San Francisco by steamer, and being infested, naturally could not land in California. They had to be returned to the shipper or shipped outside of California, and I simply insisted on those lemons going out of the State, and they went out of the State. He says, "What can I do?" I says, "Send them to Portland." He says, "I can't do anything there." I says, "Send them to British Columbia." He says, "No, we can't do anything there." I says, "Do you mean to tell me that if you can't land them where they don't raise citrus fruit you expect to land them in our country where we have the industry?" He was dumfounded. He thought we would let them go to California. They went to Chicago, and I think they stayed there, because I don't think anybody would bring lemons from Chicago to California.

MR. R. P. CUNDIFF. I think in a convention a number of years ago, a bill was prepared and presented to Congress. I think it was something like four years ago. That bill has each time been persistently fought by the American Association of Nurserymen. For what reason, I do not know. I had considerable to do with it in the first place—in getting up the bill—as we had a member of Congress from our town who was very much interested in getting that enacted into a law; but the contention of the American Association of Nurserymen was that if the Government took up the matter of inspection, our entomologist at Washington would delegate somebody in our country to inspect the importations of the American Association of Nurserymen, largely ornamental stock, coming from France; while some one should be delegated in European countries, satisfactory to our chief entomologist, to pass the stock in; and that we should not be allowed, under any circumstances, at the port of entry in the United States, to break open or interfere with a package if it came in labeled all right from such a foreign entomologist. Of course we would not consider such a law, and the amendment was defeated.

VICE-PRESIDENT POWER. Is there any further discussion on this subject? It is important, both from the nurseryman's standpoint and from the inspector's.

MR. JEFFRIES. There is one point in this matter of national inspection that is very important. About a year ago the State Quarantine Office established a quarantine against the shipment of any plants into California from Florida. We were able, in Los Angeles County, to intercept anything that came by express or freight, or any other way, except by mail. We have an arrangement in that county, as the commissioners in other counties have, whereby no trees or plants can leave the depot or express office without permission from the Horticultural Commissioners' office; nor can the plants go out from those express offices or freight offices without shipping tags, which are really certificates. We found there were plants coming in from Florida through the mails. So we went to the postoffice inspector and told him we would like to examine those plants coming in by mail. In some of the department stores in Los Angeles they have sub-postoffices, as they call them. One of these department store proprietors was also a planter and had a fine home. We found they were coming in that way. Finally we went to the inspector and told him we would like to see those plants before they were delivered: "You will notify us by 'phone whenever there is a package coming in from Florida." He did so, and for three, or four, or five weeks we had free access and examined every plant that came in from Florida or anywhere else. Finally the postmaster himself heard about it and he wrote to Washington about it, and they told him not to do it. The postmaster said to us, "You can not do it." Now, we have the plants held up in this way. Whenever a package comes from Florida, the postmaster will notify us that it will be delivered at a certain time. We are there either to inspect it or to follow it up in the hands of the deliveryman. There is the lameness in the law. It should be remedied.

VICE-PRESIDENT POWER. The next paper on the program is "Inspection Laws of California," by George C. Roeding.

NURSERY INSPECTION LAWS OF CALIFORNIA.

By GEORGE C. ROEDING, of Fresno.

That the development of the horticultural interests of California is primarily dependent on the nurserymen of the State, is, I think, a fact which will be conceded by any one desiring to engage in the business of fruit-growing. It is reasonable to suppose that the men who raise the trees and vines, unless they receive proper encouragement in their business, can not expand as they would where they are surrounded by restrictions which prevent them from disposing of their stock when ready for market. It is not my desire in this article to tell all the woes of a nurseryman, for it is only fair to say that, in no matter what business one engages, there are obstacles, and it is the énergy and perseverance which encourage us to pursue a certain defined course which finally leads on to success. Conditions in California are so different from any other section of the United States, that the men engaged in the business are dependent almost entirely for the sale of their stock to the confines of their own State. It is not necessary for me to make more than a few passing remarks about the prominent position California occupies horticulturally. That she leads all other states in the Union has been admitted for years. It is largely due to her great variety of soils and climatic conditions that her horticultural interests have been conducted along such broad lines. Those who have watched the wonderful strides she has made are fully aware that fruit-growing is still in its infancy and that there are thousands upon thousands of acres still open for development. Many of the new fruits which are being introduced by our United States Department of Agriculture will find their home in California, and probably this will be the only State which will have the monopoly of the many new industries which are sure to take their inception here. The introduction of these new fruits is necessarily dependent on the nurserymen of California, and unless they receive the proper financial support, it is hardly to be expected that they will be in the position to make the many expensive experiments in the propagating of new lines of stock with which they have had no previous experience. As I have previously stated, the nurserymen of California are dependent almost entirely for the sale of their stock in this State. This condition of affairs has been largely brought about by the fact that the varieties of nursery stock grown here are not in demand in other states, so that our business is very much restricted. Furthermore, our climatic conditions, due largely to our long, dry summers, make the growing of nursery stock very much more expensive than in many of the Eastern and Middle West states. With this condition of affairs confronting us, no large nursery can expect to exist unless it is allowed to carry on its business throughout the length and breadth of the State. The large Eastern nurseries have a wide field at their command, and much of their stock is sold at wholesale, to dealers and smaller nurserymen, who are the mediums through whom the stock is distributed to the planter. In California, the nurseryman, whether he be a small or large grower, sells most of his stock direct to the planter, with the only difference that the former has very little business outside of his own county, while the latter, on account of growing a larger variety, must necessarily have an outlet in other counties or his business can not exist. It will be readily understood that a man who has been engaged in the business a number of years, and who through close application has acquired an extensive trade, chafes under the many local restrictions under which he is placed in selling his own stock.

Strange as it may seem, nevertheless it is a fact, that under the present condition of affairs there are less difficulties in bringing stock into California from outside states, than there are in shipping nursery stock from one county to another. We have already enough pests without taking the chances of introducing new ones from outside sources. I do not wish to be understood as intimating in any way that nursery stock from other sections is diseased, neither do I wish to go on record as objecting to the importing of trees from outside sources, as long as we have a reasonable assurance that such trees are from a district where no contagious diseases exist. As an illustration of how much more easily it is to ship trees in from outside sources, I will merely refer to last season, where thousands of peach trees were imported into California from the Eastern and Middle states and were admitted in most cases without restrictions, provided they were found to be free of pests. Peach yellows, peach rosette, and other dangerous contagious diseases are liable to be introduced by allowing such stock to come into California, simply because it is impossible to trace its origin. Is it right or just, when stock from outside sources is brought in without any apparent restriction, to enforce ordinances which arbitrarily prohibit the introduction of stock without inspection? This comparison is made for the purpose of showing how much more difficult it is for a nurseryman to conduct business in his own State than it is for those whose interests are not so closely united. As a class, nurserymen have much to contend with, and although it is difficult to enact laws, except for the purpose of doing the most good for the greatest number, it should always be borne in mind that the nursery business is a legitimate calling and it should be regarded as such by our inspectors.

The State horticultural laws of California, in my opinion, cover the entire ground, and they give our horticultural commissioners all the power they require to protect the interests of the State, without having special ordinances passed restricting trade between the counties. To prevent the introduction of a certain class of stock without inspection, because an insect pest has been found in the district from which a nurseryman desires to ship this stock, places a power in the hands of our horticultural commissioners, which is, to say the least, very dangerous. If a contagious fungous disease is known to exist in a district where inspection can not determine whether the stock is infested or not, no possible objection can be made to the condemnation of such stock. Where this is not the case, however, I believe that any judge will decide that where the condition of stock can be determined by careful inspection, for Boards of Supervisors to pass peremptory ordinances, absolutely prohibiting the shipping of stock from one county to another, is not only unconstitutional, but is in every sense of the word illegal. To illustrate how unjustly these special ordinances operate, I will take up the matter of grapevines going from one county to another. No better example of this condition of affairs can be found than exists between Fresno and Tulare counties at this time. To show how unjustly the law operates, I will quote the following paragraph from the Tulare County ordinance:

> That no person or persons, corporations or association of persons, shall import, bring, convey, ship, haul, transport, or in anywise deliver into Tulare County, or any part or portion thereof, any limb, bud, or cuttings, or any grapevines of any species or variety whatsoever from any portion of the State of California south of the north line of San Luis Obispo, Kern and San Bernardino counties, and from no district within the State of California north of the north boundary line of Alameda, San Joaquin, Calaveras and Alpine counties, with the exception of Sonoma and Napa counties.

This same ordinance, however, permits the importation of grapevine cuttings without any apparent restrictions, so that nurserymen just over the border line between Fresno and Tulare counties can make cuttings in the former county and sell their rooted vines the following season without any obstacles being placed in their path.

Any body of fair-minded men will agree with me that this is a very unfair discrimination, and it is only just and fair to the nurseryman who makes and grows his vines in Fresno County that he be allowed the same privileges as the man who makes his cuttings in one county and who roots them in another. According to my views of the matter, the State horticultural law empowers the county commissioners to effectively prevent the introduction of dangerous pests without adding new difficulties to the life of a nurseryman. Most of these county ordinances seem to be directed against the nurserymen of Fresno county, and if any more of these drastic measures are enforced in neighboring counties Fresno will be inclosed within such a legal wall that our nurserymen must ultimately conclude that they have engaged in a calling which infringes on the rights of others, and will be compelled to retire from business.

A series of questions pertaining to our horticultural laws, and particularly to the authority of the County Board of Supervisors in passing special ordinances relative to the inspection and condemnation of nursery stock, were presented to Mr. U. S. Webb, Attorney-General, last winter, and the following opinion, among the several answers given by him, indicates very clearly his views relative to some of the drastic features in our county ordinances:

> Your fourth question is as follows: "If County Boards of Supervisors have authority to pass a horticultural quarantine law, can they pass a general ordinance declaring any or all nursery stock or grapevines brought into their county from any part of the world a nuisance, without any inspection of the stock?"
>
> It is my opinion that ordinances so sweeping in their nature as you describe would be held by the courts to be unreasonable and void, as arbitrarily declaring that to be a nuisance which was not in fact a nuisance. To make an occupation indispensable to the health and comfort of the civilized man, and the use of the property necessary to carry it on, a nuisance by a mere arbitrary declaration in a county ordinance and suppress it as such, is simply to confiscate the property and deprive its owner of it without due process of law.

Let us look at the matter from a standpoint of fairness to planter and nurseryman alike. Above all things, what does a planter expect of a nurseryman? He wants his stock true to name. The whole foundation of a nursery business hinges on this one point. To carry this into effect it must be obvious to any one that it is absolutely necessary to cut buds, scions, or cuttings from bearing trees and vines. As a further protection to the customer, approved methods of treating these cuttings and buds must be followed, in order to prevent the introduction of pests into the nursery. Having exercised every due precaution approved of in modern horticultural practice, is it right to take summary measures, as enforced in certain counties, of condemning stock without inspection?

It is not my desire at this time, or at any other, to intimate that the various county horticultural commissioners are prompted by a purpose of doing anything more than to do their duty in protecting the fruit interests of their respective counties. I am of the opinion that much more good would be accomplished if the commissioners were under the control of our State horticultural officials and their position was not dependent on the political complexion of every new Board of Supervisors. In the selection of men to fill the position of horticultural commissioners, their peculiar fitness for the position should be given careful consideration, and after they have shown the proper application and aptitude for the position they should be retained in office, regardless of their political affiliations. If their positions were made dependent on the recommendation of our State officials, much more would be accomplished in the eradication of pests than at present, where the office is largely a political one. It is very rarely that a pest, dangerous to our fruit interests, starts in a nursery, and a strict enforcement of the law to destroy pests in our orchards and vineyards will indirectly help the nurseryman in his vocation. It is the pests which are found in his particular county which are the cause of the passing of the ordinances so seriously affecting the upbuilding of his business interests in many sections of the State.

While on this subject, I wish to say a few words in commendation of our State quarantine officers. It gives me great pleasure to say that they have always been free from political influence; that they have fulfilled their duties in a manner creditable to themselves and to the State. Every encouragement should be given them in the prosecution of their work. When it is borne in mind that our horticultural interests are worth over $50,000,000 a year, the necessity of having competent men at the helm must be appreciated. Through their untiring efforts, many valuable predaceous insects, which have been worth millions to the State, have been introduced, and we have them to thank for their vigilance in preventing the introduction of pests from Australia, China, Japan, and Mexico, which would have wiped our fruit interests out of existence. If these men were empowered to enforce special regulations when necessary, to protect one section of the State against another, much good would be accomplished and the friction which now exists between nurserymen and county horticultural commissioners would be eliminated. A nurseryman should be given just as much consideration by the horticultural commissioners as they would accord a fruit-grower. Could they only realize the many difficulties under which nurserymen operate, they, I am quite sure, would be more considerate and would strew our paths with roses instead of thorns.

MR. LEONARD COATES. Mr. Chairman, Ladies and Gentlemen: I would like to supplement by a word or two what Mr. Roeding has just said, by saying that any one who will take the earliest reports (I think they are reported in one volume) of the different county ordinances from the far north of California to San Diego, and read them carefully, he will find them so full of inconsistencies, absurdities, and contradictions that there could be only one opinion on the matter. You will find that various counties are so hedged about and legislated for or against without any sense or reason. You can begin in the far north of the State and go all the way down, and you will find yourself chased from Siskiyou to San Diego and over the borders. You won't find a resting place in California. A stranger might take that book of ordinances and he certainly would come to the conclusion that there was no healthy climate, no soil, in California which could raise healthy fruit or trees or anything else in an agricultural way. There is no spot exempt, all depending upon the perhaps well-intended but misguided judgment of the various Boards of Supervisors.

I wish I had the volume here to read from, but I remember in reference to pear blight certain localities in certain counties are so described and mentioned that one is led to the conclusion that a surveyor's chain absolutely and arbitrarily prevents the introduction or the dissemination of pear blight, on one side rich with disease, on the other side such a high, imaginary wall built up that no winds could carry the microbes or bacteria over it.

There is one portion of the State which every pear-grower knows is full of pear blight, and that part is not legislated against; and so we find those inconsistencies and absurdities. It only shows us, as Mr. Roeding has pointed out, the need for a different legislation, one emanating from and controlled by the horticultural commissioners at headquarters. Supervisors may mean well enough, but their object is to please their constituents. They want to go on record as saying something very nice about their particular locality, a few miles here and there, a few spots which are exempt from all disease. And therefore they pass these ordinances merely to please and flatter a few of their constituents without knowledge or real regard for the conditions. That is the way I look at it, and the way any one would look at it reading those ordinances and taking them up one by one—that there would be no healthy spot and no healthy tree grown.

MR. H. W. BYRON. Mr. Roeding complimented the quarantine officers on doing their duty. What do they have to do? To keep foreign pests out. Why is it we pass our county ordinances? It is not to make friends with Tom, Dick, or Harry at all. It is a noted fact that Fresno County has disease and Kings County hasn't got it. We haven't got it in Kings County, and we don't intend to have it, if possible.

MR. JUDD. I rise to discuss this question without any very great knowledge except of various localities. In Santa Cruz County we have an ordinance, and it is a sweeping one, and it was not gotten up just for puff; it was gotten up for the purpose of saving at least 15,000 acres of apple trees, and maybe 1,500 or 2,000 acres of pear trees. It is sweeping in this sense, that it says that there shall be no trees enter the county of Santa Cruz from any section where the pear blight is known to exist. We don't put a surveyor's chain on and pick out any particular locality, but they can't come from anywhere. That is the law with us, and it was for the sole purpose of protecting the industry of the Pajaro Valley and Santa Cruz County against the pear blight.

MR. P. D. FOWLER. I simply desire to mention Mr. Roeding's statement in reference to the ordinance of Tulare County against the importation of grapevines. The part he read excluding rooted grapevines is correct; but he went on to say the ordinance made no provision for cuttings, that we allowed them to come in and be distributed regardless of disease. Our ordinance expressly provides that cuttings anywhere outside of Tulare County must be fumigated. We don't believe that rooted vines can be fumigated without killing the vines. It can be done on cuttings, and for that reason we fumigate the cuttings. I don't know that it is necessary to defend that ordinance. It has been discussed in all its phases, and, as he says, has been turned down by one judge in the valley. That does not settle the question at all, and it will not be settled until it is carried through all the courts. But whether that ordinance is legal or not legal, we contend it is just, and we are willing to stand on the justice of it until the court decides against us.

MR. JEFFRIES. I think Mr. Roeding and Mr. Coates have made a mountain out of a molehill. Los Angeles County and many of the other counties have no ordinance against anything. When a man comes into my office and wants to know where he can get peach trees or apple trees, or what-not, I tell him. He says, "He is sold out." That is the way Mr. Roeding is suffering. I don't see what you are going to do about it.

MR. PEASE. Our ordinance is after the ordinance of Los Angeles County. We don't prohibit any stock shipped into our county from Roeding's nursery with the exception of grapevines. The reason we are careful about that is because it is so difficult to see phylloxera on the vine. I have shown it to a great many men and they have looked at it and said they did not see anything. So you can see how a competent nurseryman might pass over the same thing. It is the difficulty of trying to pass grapevines infested with phylloxera that has caused us to pass this ordinance.

MR. FOWLER. After all the talk about barring out pear blight, Tulare County has never barred anything from any place except grapevines.

MR. PEASE. If we can't find anything on them, we let them go in.

RESOLUTION RELATIVE TO AMENDING THE CHINESE EXCLUSION ACT.

VICE-PRESIDENT POWER. There was a resolution introduced this morning, which was out of order at the time on account of other business taking place. That resolution is now in order and I will ask Secretary Isaac to read it.

The Secretary then read the following resolution:

WHEREAS, Farm labor is becoming increasingly difficult to obtain, and in California especially the great fruit and wine industries are therefore threatened with disaster; therefore, be it

Resolved, That the fruit-growers of California in convention assembled favor such amendment of the Chinese Exclusion Act as will permit the enactment of laws making possible a restricted immigration of laborers, irrespective of nationality.

And that the Secretary of this Convention furnish copies of the above resolution to our representatives in Congress.

MR. JUDD. I move the rules be suspended and the Convention deliberate on its adoption at the present time. If the Convention will suspend those rules, we can discuss the proposition at this time.

MR. COATES. I second the motion.

MR. SPRAGUE. I think it is unwise to do this sort of thing almost any time, particularly at present. There is a resolution that is being carefully considered by the Committee on Resolutions. Now, we have a practice of referring resolutions to the Committee on Resolutions, and the reason for it is to prevent such conflict as I have just referred to. It seems to me it would be much better to let this take its usual course.

MR. JUDD. I would like to hear from the chairman of the committee.

JUDGE AIKEN. It should be referred to the committee, for we have had that subject under discussion and will be able to report soon. If there is any resolution that should be referred to the Committee on Resolutions that is the one.

VICE-PRESIDENT POWER. The motion was made to suspend the rules. That matter is in your hands. If the gentleman will withdraw the motion, I will be pleased to refer it to the committee.

MR. JUDD. I withdraw the motion, and the Committee on Resolutions can meet in three minutes and we will report it back, and we will report it back just as it is.

VICE-PRESIDENT POWER. Does the party who seconded the motion wish to withdraw it?

MR. COATES. I believe I seconded it. I will withdraw my second.

MR. DORE. I want to see a resolution embodying the substance of this resolution adopted by this Convention. I would like to have the unanimous support of the Committee on Resolutions. We will discuss it, and if its language is not entirely satisfactory, let us modify it until it is. I believe that the time must come when we must voice our wishes for a modification of this Act. At the time when this matter was before the fruit-growers in San Francisco, there was a sort of hoodoo. A very complete discussion was had. The resolution was adopted by a good, fair majority; and yet I do not remember that a single San Francisco paper published that part of the proceedings of the Convention. We have to meet that sort of influence, and we will have it to meet while politicians manipulate the newspapers of the city.

Now, I say that we ought to have our committee consider this matter and take it up in a harmonious way. We are all of us eager to take whatever action will be most judicious, so that we can stand before the people of this State, and stand firmly upon our feet, demanding what is in the interest of all of us.

VICE-PRESIDENT POWER. The maker of the motion and also the second ask to withdraw it, so that it can be turned back to the Committee on Resolutions and by them returned to the Convention at the earliest possible moment. This will be done if there is no objection. Is there anything further to come before the Convention?

RESOLUTION RELATIVE TO THE DISTRIBUTION OF SEEDS.

PROF. WICKSON. May I offer a resolution and ask that it be referred to the committee? I will ask for the reading by the Secretary.

Secretary Isaac then read the following resolution referring to the appropriation made by Congress for the distribution of seeds:

WHEREAS, Congress appropriates annually $242,000 for free seeds, and the Postoffice Department expends annually about $250,000 in the distribution of the same; and

WHEREAS, These seeds being mostly of common varieties easily obtainable in the market; be it

Resolved, That it is the sense of the fruit-growers and nurserymen of California, in joint convention assembled, that much more good would result if this money were used to aid the Department of Agriculture and the State Experiment Stations in the securing, growing, and distributing of rare and valuable seeds and plants which might prove of economic and commercial value to the people of the United States.

VICE-PRESIDENT POWER. If there is no objection, it will be referred to the Committee on Resolutions. If there is nothing further to come before the Convention we will take a recess until 7:30 o'clock this evening.

EVENING SESSION—SECOND DAY.

WEDNESDAY, December 5, 1906.

The Convention was called to order at 7:30 o'clock. President Cooper in the chair.

PRESIDENT COOPER. The first on the program this evening is "Pear Blight Conditions," by Prof. M. B. Waite. I suppose you all know why he is in this country. He has made several trips across the continent, and has instituted a very vigorous fight against the pear blight, and he will be here most of the winter. After his essay on the pear blight, he will take up peach blight this evening, and also by special request of many of the members he will again take up peach blight on Friday morning. It will be the first thing Friday morning, and I would make a request now that the members try to get here as near 9:30 o'clock as possible, because there will be considerable discussion on this question, it being of much importance. I introduce to you Prof. M. B. Waite. Mr. Power will preside this evening.

PROGRESS OF PEAR BLIGHT CONTROL IN CALIFORNIA.

By PROF. M. B. WAITE,
Pathologist in Charge of Diseases of Fruits, U. S. Department of Agriculture.

At the last annual meeting of this Convention at Santa Rosa the writer gave a paper on pear blight work and its control in California, and Prof. Ralph E. Smith, of the State Experiment Station at Berkeley, read a paper entitled "Pear Blight Work in California." These two papers, which were afterwards printed in the annual report of the State Horticultural Commission and were extensively distributed in pamphlet form, gave a pretty full account of the conditions in regard to pear blight in this State up to December, 1905, and render unnecessary any elaborate description of the disease, its cause and the life history of the germ which produces it, methods of control, and factors governing infection and spread of the blight. The coöperative work carried on by the Bureau of Plant Industry, the California Experiment Station, and the State and County Horticultural Commissioners was explained fully in these papers, making further explanation unnecessary. Presumably, therefore, I am called upon to give a progress report describing the work and results since the Santa Rosa meeting.

Treatment of the Disease.—At the risk of repetition it may be advisable to give briefly an outline of the treatment of pear blight. This treatment depends on a careful investigation of the cause of the disease, a study of the life history of the microbe which produces it, and of the various influences or factors which control its infection and development in the tree. The preliminary treatment or main method of control consists in thorough eradication of all the hold-over blight when the tree is in a dormant or semi-dormant condition. To carry out this method fully requires very careful inspection of the trees, and thorough and skilled work in the eradication. Frequently it demands the entire destruction of badly infected trees when the blight has run down to the body or girdled the tree at the soil line, or has spread out into the roots. In pruning, a disinfectant has to be used, preferably corrosive sublimate, to keep the tools and cut surface free from contamination with the virus of the blight.

The secondary methods, often more or less successful and of varying practicability, consist of spraying the bodies of the trees or whitewashing them with lime-sulphur-salt, or other disinfectant washes, for sealing up the hold-over blight which had been overlooked and for keeping away flies and other insects which may carry the disease.

Summer cutting is also a valuable secondary method in fighting the disease. Summer cutting is of variable success. Invisible or new infections may develop after the most thorough cutting out, and even when great care is used the blight germs during the active growing season may extend considerably below the discolored part.

The removal of water sprouts and fruit spurs low down on the main branches and bodies of the trees is also of value.

The style of pruning and the severity of pruning of the trees also have their effects. Low-spreading, vase-form trees are of the most desirable shape, and moderate pruning is advantageous while fighting blight in the pear orchards.

The question of resistant varieties and stocks was also discussed as a means of partially avoiding the losses due to blight on the bodies and collars and below the soil line.

Moderation in cultivation and manuring and in irrigation is helpful.

Work in the Spring of 1906.—Upon reporting to Dr. B. T. Galloway and Dr. A. F. Woods, Chief and Assistant Chief of the Bureau of Plant Industry, that additional men were needed in this work, they promptly endeavored to supply the need. Fortunately, Mr. W. A. Beard, Secretary of the Sacramento Valley Development Association, was in Washington at the time, and when we were about to fail on account of the expense money, he secured, through the influences of Mr. Diggs, President of that Association, and Lieutenant-Governor Anderson, the means by which these men were placed in the field in addition to Mr. W. M. Scott. The Southern Pacific Company very generously supplied transportation west of Chicago and New Orleans to all our men. Accordingly, Messrs. Shear, Miles, Swingle, Spaulding, and Gilbert were put to work in the orchards. These men worked in close coöperation with the State Experiment Station men in the inspection and instruction work, often forming a part of the same crew. This additional force came rather late in January and was scarcely well started before the first of February. The work was necessarily somewhat hurried in order to cover the ground, and then many orchards were never even visited. The plan was to give every pear orchardist in the State an opportunity to become familiar with the methods of blight eradication, and the attempt was also made to give a tree-to-tree inspection. On account of shortness of time this was only partially carried out. Furthermore, the best time to do this work is in the fall of the year. In fact, the month of November may be considered the most desirable month for fighting pear blight.

Through the interest of the County Horticultural Commissioners a number of inspectors were set at work in several of the pear-growing counties. These inspectors were instructed by the Department and State pathologists, and often formed a part of the same inspecting force. In spite of this effort to assist the orchardists it became more than ever apparent that the brunt of the work in the orchard has to be done by the orchardist or by his trained help. Some orchards were certainly very well worked, though probably perfection—that is, complete eradication—can hardly have been accomplished, or at least only in a limited number of orchards. Fairly good work was done in many orchards here and there in the pear district, but as a rule the proportion of well-worked orchards was, I regret to say, rather small. In some striking instances trees with the blight running down into the bodies and into the roots, which were plainly and admittedly beyond saving, even though they may have been marked or condemned by the inspectors, were left until after the blooming period, and infected the blight far and wide in their vicinity.

Meetings and discussions with pear-growers were held, but especially field demonstrations, which had been started in the spring before, were given in many of the important pear districts.

It takes a lot of instruction and demonstration work to get the growers actually interested in the control of the blight and to properly instruct them in the methods of doing the work. It is also hard to get them convinced of their own power and ability of controlling this tiny microbe.

Results in 1906.—In March, 1906, when the pear blossoms began to open, the eradication work may be said to have been only fairly started, with the notable exception above indicated. Many trees were pulled out and large quantities of fresh blight were found on the roots, especially while the trees were in the bloom; many other condemned trees were still in the ground. It may be safely said, therefore, that while the amount of hold-over blight had been reduced in a few orchards that had been well worked, great quantities of it remained in the pear districts. Several of the Experiment Station men remained in the field to observe results, and Mr. Deane B. Swingle, of the Bureau of Plant Industry, remained until June.

As to the amount of blossom blight, which is the direct result from infection from the hold-over, it is plainly evident that in the spring of 1906 it had been reduced materially in all of the better worked sections. This spring probably was not especially favorable for the distribution of blossom blight. One peculiarity, however, developed in the way the blossom blight had scattered. Blossom infection, instead of being clustered in colonies around the hold-over cases, appears to be scattered lightly and widely throughout the orchards. Had the spring been dry and the rains stopped earlier in April, as has often been the case in this State, the blossom infection would doubtless have resulted in but little damage and it could have been easily removed by summer cutting. Unfortunately rains continued through April and May and even into June, and the infection periods were so intense that a very unusual amount of twig blight resulted. This often happens in the Eastern

States, where our rainy summer prevails, but was scarcely expected in California. The same conditions undoubtedly caused a great many infections on the water sprouts and sprouts which come from the French stock on the base of the trees and from the roots, and possibly also favored infection in the fleshy bark on the trunks of young trees or the tender bark at the soil line on larger trees. The conditions were very similar to those in the spring of 1905.

In visiting the orchards this fall it is apparent, therefore, that the blight has made great progress in its destructive course. During the last season many orchards only slightly attacked in 1905 have gone down badly and even been destroyed beyond recovery during the last season's outbreak. This is particularly true of many vigorous young orchards north of Sacramento in the Sacramento Valley. It is also true of very young orchards which I have visited in the lower Sacramento River district below Sacramento and in fine orchards of Yolo and Solano counties.

Present Conditions.—In Sacramento County in the strip of orchards along the river many instructive lessons can be learned from the behavior of the blight. In a large orchard near Walnut Grove, where efforts were made to secure eradication and where the trees affected below the ground line had been carefully marked by three hacks in the bark, these trees were not dug up and still remain, at least in part, to this day. The result was exactly what might be expected. The blight was already bad in the orchard, but now the orchard is a wreck and ruined beyond recovery. Probably over seventy per cent of the trees have the blight running down into the roots, many have their tops nearly totally destroyed, and all have many blighted limbs. On Steamboat Slough there are a number of very fine young orchards whose proprietors probably intended to eradicate the blight, but the work was not done early enough to finish, resulting in very great losses.

A number of other orchards, notably those in the vicinity of Courtland, stand out in marked contrast. I can refer particularly to the orchard of Mr. Ernest Gammon, near Courtland. This was the first orchard which I visited on beginning this work in February, 1905. Mr. Gammon started the work at that time, but was unable to secure very complete eradication that year. Last winter, after more experience and with better help, his work greatly improved, and while considerable blight occurred during the past season it has not been unreasonably severe; and standing the other day in the part which at first had been most affected it became evident that while losses had been sustained the fight had been victorious in the main. Mr. Barry, Mr. McCollough, and several other orchardists in the vicinity of Courtland can point to similar results. I can not say that these gentlemen have not been discouraged at times and still feel uncertain as to the outcome;

however, many of the Sacramento River growers now begin to realize that with careful, painstaking work, continued over a large area, the blight can be controlled. Mr. Hayward Reed, in his orchard opposite the city of Sacramento, has been particularly successful in fighting the blight. On the Pierce ranch, near Suisun, of which Mr. George Reed is superintendent, very excellent work has been done, and the orchard stands to-day in fine condition as a splendid example of the possibilities of blight eradication.

At Marysville and Yuba City a number of affected orchards have been very badly attacked during the past season and the owners in several instances have given up the fight; however, the orchard of Mr. Howard Reed is a splendid example of the results of the thorough carrying out of eradication methods. I may say, however, that the results have not in all cases over the State followed exactly as expected. Some badly blighted orchards that have been poorly worked have had less blight than anticipated; on the other hand, some of those little affected or carefully worked have had a bad outbreak during this year. These exceptions to the rule are, of course, to be looked for. There are so many variable factors concerned in the spread of blight that it is by no means possible to keep track of them all.

In the upper Sacramento Valley, in Butte, Tehama, and Sutter counties, many fine orchards have been destroyed during the past season. It is certain, however, that in most of these abundant hold-over blight was left either in the particular block or in the community. The fine orchard on the Cone ranch at Red Bluff is in a very good condition. Considerable blight attacked the orchard this year, but undoubtedly some hold-over blight was left at the base of the trees last season. At any rate, the infection in this orchard could be accounted for through the numerous cases of hold-over left in the vicinity, even though it was clean when spring opened. Instead of being discouraged at the outcome, however, Mr. Ramsay, the able superintendent, is now at work with a crew of men doing more and better eradication work than ever before. A few trees will be dug up, certainly only a small percentage however, but the blight, at least what can be found by the most careful work, will be removed.

In the foothill orchards of Placer County which center around Newcastle the blight has made only moderate progress during the past season. With a very few exceptions the orchards are all standing in good shape, although infection is quite general. As the pear blight methods become better known, more thorough eradication will probably be carried out in this district.

At Vacaville and Winters the condition is still rather bad. The blight has increased to a marked extent in many orchards, some of which were already damaged beyond recovery.

The loss of so many fine orchards in Solano and Yolo counties, and especially the severe losses in the upper Sacramento Valley, are certainly to be regretted, especially as it seems to me an unnecessary loss. If the growers would take up the work enthusiastically and thoroughly it is believed these orchards might have been saved. As it is now, more than half of the blocks of pear trees north of Sacramento, at least those which I have seen, are injured beyond saving. This, however, should not be discouraging to the skillful grower, because it renders pear-growing more profitable to those who succeed. It may cost more money to maintain an orchard and fight out the blight, but high prices will doubtless increase rather than decrease the profits in the business.

Blight has spread very badly on the apples in Northern California and has even attacked scattering orchards far into the Sierras. During the last year the writer found the California holly attacked by the blight at Vacaville. This is a member of the pome family and a relative of the pear and apple. After repeated examinations it was finally found attacked. It is evidently not a very good host of the pear-blight germ, however, but can harbor it under favorable conditions. It seems to me that on the whole, while the possibility of complete eradication seems to be rather remote, the behavior of the blight in the well-worked orchards gives more and more encouragement to those who will take the necessary pains in eradicating this disease.

Work During the Present Winter.—The Bureau of Plant Industry is giving more attention this winter than ever before in aiding the pear-growers in this fight. Instead of having the men here at the close of the fighting season, a number of competent pathologists were put in the field early in November to continue through until the blossoms open. The total number of Department men engaged in the work during the winter will be seven. Besides the writer, Mr. W. M. Scott, who was here last season, will be on the ground and in charge of the work during a portion of the time. Mr. P. J. O'Gara will be located at Newcastle and will look after the foothill orchards. Mr. W. F. Farot will be located at Suisun and will work in Solano and Yolo counties. Mr. George F. Miles will be located at Courtland and will spend his time in Sacramento County. Mr. James Burch Rorer is at present at Courtland, but will spend part of his time in the orchards around San Francisco Bay and the lower San Joaquin Valley. Mr. W. S. Ballard is at Vina and will devote his efforts to the upper Sacramento Valley.

It is our aim to give every horticultural commissioner or his inspectors an opportunity of getting instruction in the best possible methods of controlling this disease. Our men act as instructors or advisers to the orchardists in their fight against the blight. Some orchards we can actually inspect, or even in a few cases do the work on certain trees ourselves, but as a rule the real work must fall on the grower. Therefore, the future of the California pear industry depends upon the skill and success of the California growers in carrying out these methods.

California Pear-Growers' Association.—During the past summer a new and powerful element has come into the campaign against pear blight. Stimulated by the Sacramento Valley Development Association, and encouraged by favorable opinions of many leading horticulturists in the State, this Association issued a call for a meeting of pear-growers in August in the city of Sacramento. As a result, the California Pear-Growers' Association was formed. The main object of this Association is to advance the interests of the pear-growers, and especially to assist by unity of action in the fight against the blight. Its expressed purpose is to encourage and work in coöperation with the Government and Experiment Station experts and the State and County Horticultural Commissioners. Lieutenant-Governor Alden Anderson was elected president and Mr. W. A. Beard secretary. Subsequently Mr. O. H. Miller assumed the duties of secretary as acting secretary.

It is a great help to the cause to have the aid of this powerful organization. Branch organizations have been formed in several counties, and already have materially aided in pushing this work forward. The Association officers realize that an important phase of the work consists in cultivating public sentiment in favor of thorough eradication; in other words, a great deal of our hardest work, up to the present time, has been in dealing with men rather than with pear trees and microbes. This work the Association, through its influential officers and branches, is much better prepared to undertake than the bacteriological experts.

REMARKS ON PEACH BLIGHT.

By PROF. M. B. WAITE.

Now, let us turn from this rather difficult, and perhaps rather gloomy subject, to one that is comparatively easy, to one in which the outlook is very promising, very rosy, while, nevertheless, the disease is a serious one, and, just at present, is particularly annoying to the California peach-growers. I refer to the peach-gumming fungus, or the California peach blight. It is also discussed under the name of the "shothole disease," or "shothole fungus."

This appears to be one of the easiest of all plant diseases to prevent. It stands in marked contrast with pear blight in many ways. Instead of being a disease which can be handled only by the eradication method, and which requires an enormous amount of strong and unanimous action over large communities, in which one man is dependent on many other men, it is a disease in which one single orchard can be treated, one single row of trees, or even a single tree, or perhaps a single twig can be treated and thoroughly prevented from having this disease.

On my first trip to California, early in February, 1905, when I visited Mr. Cooper's office in the Capitol at Sacramento, Mr. John Isaac, secretary of this commission, handed me a bundle of twigs of this peach fungus, which he said was particularly troublesome in California—in fact, was almost, if not quite, as bad as the pear blight as a disease annoying the California fruit-growers. Fortunately there was microscopical equipment there, and after a few moments of examination I was able to tell Mr. Isaac that the disease was caused by a microscopic fungus with a very jaw-breaking name. I don't know whether it will hurt or not if I remember it here. It is named after a Swedish botanist by the name of Beyerink, and the Latin name is *Coryneum beyerinkii.* It is a tiny brown fungus with smoky-brown spores. It grows very rapidly; in fact, the spores can hardly wait until they are developed until they begin to sprout and germinate.

A few days later, when visiting the orchards at Suisun in company with Professor Ralph Smith, of the California Experiment Station at Berkeley, the full importance of this disease was shown to me for the first time. In studying the pear blight at Suisun with a number of Suisun growers, they took me into the peach orchards and showed me the destructive character of this disease. The trees were certainly in very bad condition. The annual twig growth was covered with little brown spots which were eating through the bark, even into the wood, and on many of the trees ninety, on some even ninety-five per cent of the buds had been evidently attacked and killed. In many cases gum was issuing from the spots. Later on, when the rains came on, there were very copious exudations of gum from these brown spots.

When I saw the serious character of the disease, I was also asked for treatment, and I replied at once that it was of a nature which could be prevented by the Bordeaux mixture. In other words, it looked like a typical fungous disease of the character usually prevented by spraying. I asked the Suisun growers if they had tried the Bordeaux mixture. They said they had, and that it had failed. Upon questioning them closely, and being shown a sprayed orchard, I was informed that the trees had been sprayed about the first of February, only about a week or ten days ahead of my visit there; but the spots were plainly three weeks to a month old; at least they had evidently grown before the Bordeaux mixture was applied, and the Bordeaux mixture was resting on top of a good many of the bad spots. The suggestion was then made that spraying must be done well ahead of the first infection.

Upon discussing this matter with George Reed, J. S. Brown, and J. R. Chadbourne, they promptly agreed to try this early spraying. The suggestion was made that early winter or fall spraying would be the thing to try as a remedy for this disease. And that proved to be the key to the whole situation.

During the fall, Mr. Reed, Mr. Brown, Mr. Chadbourne, and some others made a test of Bordeaux mixture against this disease.

On the William Pierce ranch, at Suisun (Mr. George Reed, superintendent), they began spraying their peaches December 6, 1905, and sprayed a number of trees with strong Bordeaux mixture. The formula used there was fifteen pounds of bluestone, twenty pounds of lime, and a hundred gallons of water, making a very strong Bordeaux mixture. We do not consider the exact formula particularly important, as I will show later. Part of the trees were sprayed again when the buds were swelling, about February 1st, and at that time what we call a 5–5–50 Bordeaux was used—the ordinary standard Bordeaux. Through the courtesy of Lieutenant-Governor Anderson, who is connected with this orchard, the facts about the fruiting of that orchard were mailed to me at Washington later in the season.

Mr. J. S. Brown, of Suisun, sprayed the last week in December, and used the same strength of Bordeaux, or about the same. He made only one treatment of his trees, but they were not as badly affected as the orchard on the Pierce ranch.

Mr. J. R. Chadbourne sprayed a little later, early in January, using a single treatment.

When I visited these orchards in February, 1906, about a year after the first time I saw them, the effect of the spraying was very apparent. Wherever the trees were well sprayed (and most of these were very well sprayed), the bark was smooth and bright and scarcely a spot to be found. The buds were all intact, and by going to adjoining trees, or in many cases, by merely climbing the fence and visiting the adjoining orchards, very bad conditions, similar to those obtaining the year before, were apparent.

This beneficial result continued through the season. On the Pierce ranch, as I said before, they sprayed part of the trees a second time just as the buds were opening. These trees had been very badly affected, had produced little fruit for two or three years, and if we may judge by the behavior of similar trees in the immediate neighborhood, would have produced very little fruit during the past year. The results showed slightly in favor of the double spraying; that is, of an additional spraying at the time the buds were swelling, on February 1st.

I will give you some of the yield from this orchard, as it was given to me by the owners. In this block of sprayed trees, 402 trees of the Wager peach yielded just 100 tons of peaches; 180 trees of Lovells yielded 42 tons of peaches. Similar results were obtained in the other blocks; that is, very high yields,—so high, in fact, that Mr. Reed told me the other day that few people were willing to believe the figures which they had got from their peach crop this year, on account of the universal failure in the neighborhood.

Mr. J. S. Brown, with his single treatment on Muir and Phillips Cling, had fine results, splendid yields, and a very good quality of fruit.

Mr. J. R. Chadbourne had about the same results.

The orchard of Mr. J. R. Davidson, near at hand, was treated under the direction of Mr. George Reed, but spraying was not begun until some time in January. The earliest spraying was partially successful.

This is a point to bear in mind: that even after the first of January very good, but not completely successful, results were secured; but the late January spraying was practically a failure. I saw that result, and examined these trees myself when they were in blossom. Part of the trees, even though they were somewhat peppered with Bordeaux mixture, had a lot of peach blight on them, and a lot of the blossoms failed to open, because the buds were killed, and some of the blossoms were shriveling on the trees.

Fortunately, therefore, the California peach-grower has for the coming season more than theory or a suggestion, which was all we were able to give a year ago. He has a demonstrated fact that Bordeaux mixture is a specific for this disease.

The only questions that remain to be determined are the incidental ones in regard to this treatment: How early must we begin, to be safe? Was last year a normal season? It was a very dry fall. Possibly with a warm, early fall infection may take place earlier than December 15th, and, therefore, spraying on the first of January or the last week in December will not be so successful. Furthermore, in the treatment of the fungus in the Eastern states, the people use what we call the standard Bordeaux mixture, 6–4–50, or the new standard mixture, 5–5–50; that is, five pounds of bluestone, five pounds of lime, and fifty gallons of water. That has given just as good results when thoroughly applied as when more copper was used. Copper is particularly scarce in California just at present, so that any saving in this is worth while. We believe that the 5–5–50 formula will do just as good work as the stronger mixture, if it is thoroughly applied. In other words, the results will depend on thoroughly coating the twigs rather than on the strength of the mixture. Bordeaux mixture is not a matter of strength so much as a matter of getting the copper on the trees. You can overspray, and double spray with a dilute mixture, and get just as much copper on as you get with a strong mixture poorly sprayed, and the mixture must be on the particular spot to produce results. Some men, in their efforts to fight this disease, are inclined to overspray and waste a lot of material—to spray more than is necessary down on the bodies of the trees and down on the ground. Yet I am rather afraid to caution on that line for fear you will do as some others do, spray too lightly. It is not necessary to waste any amount of copper; it is not necessary to spray heavily on the limbs and branches. Do your work on top, and much of the spray will fall down anyhow. By the time you have got the top sprayed, you have partially sprayed the lower part; and then follow down to the base of the tree. The trees have to be sprayed on all sides. It does not require the thick, heavy coating that you are used to applying with the lime, sulphur, and salt, but it requires a continuous coating which will very thoroughly pepper with the Bordeaux mixture.

Now, as an ordinary, safe treatment, we should say, with present knowledge of this disease, that the spraying should all be finished by December 1st. The first treatment may be made late in November or very early in December. A second treatment may be made just about the time the buds are beginning to swell, from January 15th to February 1st. Perhaps it may be necessary in an ordinary rainy fall, which we sometimes have in California, to begin this spraying early in the autumn, just as quick as the leaves are off; or it may possibly be desirable to spray with a solution of bluestone without any lime—just spray bluestone early in November and cut the leaves off, because a few days later they fall to the ground—say a solution of four pounds of bluestone to fifty gallons of water; and then come around after the leaves have fallen and spray with standard Bordeaux mixture. That is to say, we might not be willing to wait for the leaves to fall before we begin to spray the twigs, but the leaves have to be off before we can do a real thorough job of spraying the twigs for this disease.

We are also carrying on a series of experiments, testing different materials, different strengths of Bordeaux mixture, and the possibility of using lime, sulphur, and salt. We are also going to try the Oregon wash, which consists of lime, sulphur, and salt, to which bluestone has been added. We may be able to kill the scale and fungus at the same time. We are also trying to increase the sticking power of the Bordeaux mixture. The plain Bordeaux mixture can be improved by the addition of soap and other materials which we are testing. The more of these experiments, the better the information will be next year for the California peach-growers. Furthermore, the peach orchards are being very widely sprayed over the State, especially up the Sacramento Valley, and the orchardist himself is going to have lots of experience in fighting this disease. It may be that we can use other mixtures as well as the Bordeaux mixture. One thing is certain, that we have an absolutely safe specific for this disease, and it is only a question of work to prevent it.

VICE-PRESIDENT POWER. The next on the program is "Recent Work in Entomology," by Prof. C. W. Woodworth.

RECENT WORK IN ENTOMOLOGY.

By PROF. C. W. WOODWORTH, of Berkeley.

It was at first my intention to treat this subject in the broadest possible manner, reviewing the progress now being made in practical control work against insects in all parts of the world and pointing out the lines along which the best progress has been made, especially by the most recent studies, with the object in view of indicating the most promising questions for future study. A great deal of data was brought together for this purpose and some progress made in the preparation of this paper when the report of the Office of Experiment Stations of the U. S. Department of Agriculture for 1905 came to hand containing an elaborate discussion of the same subject by Dr. Wilcox of that office, limited however to the work of the American Experiment Stations along this line. So well did he arrange the data that what I will have to say may be considered in some ways a commentary from a Pacific Coast point of view of that more extensive article. The fact that the author of that publication limited himself to the work of the Experiment Stations of the United States does not materially narrow the point of view, since a comparison of the data he presents with that gathered together by myself for this paper made the fact evident that the contributions to the methods of practical insect control work of a noteworthy character have of late years been almost exclusively the work of these Experiment Stations. The economic entomologists of other countries are far behind our own workers, as a rule, though a few of them are doing very good work; in every case, however, problems of significance to us here have been handled by American entomologists in a manner at least as satisfactory as by foreign workers. In this respect the passing generation has seen a great change. In the earlier writings of that greatest of economic entomologists, our own honored and lamented Prof. C. V. Riley, there were many references to the backward condition of entomological science in America. He did more than any one else to place American entomology well in the front rank. The magnificent work of Rotzeburg in Germany, of Curtis and Miss Ormerod in England, and a host of brilliant workers on the phylloxera problem in France are all of the past. The American Experiment Station workers have taken up the work where Riley had placed it and have maintained the preëminence he so clearly won. This paper would fail of doing justice if a tribute was not paid to three institutions antedating the active work of Riley himself. I refer to the Division of Entomology of the U. S. Department of Agriculture and the office of State Entomologist of New York and of Illinois. These three offices are the only ones that are making large and notable contributions to this subject in America outside of the work of the Experiment Stations. The U. S. Division of Entomology was practically created by Riley and is by far the best equipped and supported entomological department in the world. The U. S. Entomologist controls a body of assistants nearly as great in number as all the Station entomologists combined, and spends an annual appropriation almost or quite as large as the combined sum available for salaries and expenses of the Station workers. Each of the two State Entomologists mentioned have also more men and means than the entomological department of any Experiment Station. Several other states have entomological departments supported as well or better than the average Station entomologist, but either the quality or quantity of the work produced has not been such as to attract much attention, though in justice perhaps a few of them should be mentioned here.

The Experiment Stations of the country have easily produced the best and largest results, in proportion to the cost, of any existing agency for the study of the problem of insect control. The quantity of the work produced by the Stations may be appreciated from the fact that nearly 4,000 publications devoted exclusively to entomology have been issued by the Stations.

The recent progress in this subject is of particular interest to California growers. In the article above cited the author, Dr. Wilcox, selected 106 publications for review, or about 2½ per cent of these publications; these contained, according to his conception, the most noteworthy contributions. Ninety of these are of immediate interest to the Pacific Coast, and eleven were studies made by the California Station. It is a matter of considerable personal gratification to note that Dr. Wilcox has selected a considerably larger number of publications from this Station than from those of any other existing entomological department.

In the following remarks I will limit myself to this 2½ per cent of the Experiment Station's entomological publications selected as the more important contributions by Dr. Wilcox, and will choose therefrom those studies most pertinent to our California problems.

Foremost among the results obtained has been the thorough testing out of the lime, sulphur, and salt wash. In Bulletin No. 166 of this Station is given an account of the first discovery of the value of this wash. Its practical use in this State for many years had long ago established its place in the opinion of our growers. Now through the careful, scientific studies of the Station entomologists of a dozen states, we have knowledge of its efficiency under a great number of climatic conditions and with a great variety of methods of compounding it, as well as much data upon the time and method of its application. In the past here locally in California this mixture has been used and its good qualities appreciated by many, but without definite knowledge as to its limitations or range of availability. Venders of insecticides of all sorts have been able to throw discredit on the material and induce growers to substitute their nostrum. Our own studies made here at Hanford by Mr. Quayle and the other studies just referred to have finally settled many of these problems, and this mixture now takes its place among the fully tested standard insecticides. Though much has been accomplished in the study of this insecticide, much more still remains to be done. The substitution of a ready-made lime-sulphur mixture is a great desideratum, since its use is practically limited at present to large-scale spraying work, on account of the inconvenience of manufacture. Even in orchard spraying a ready-made mixture would be a great convenience if the cost were not too great. Such mixtures are already being placed on the market, but can not secure the indorsement of any careful entomologist, because they are not tested as carefully as the standard mixture. We must learn the principles upon which the efficiency of these substances depend and learn what effects the various ingredients of a lime-sulphur mixture produce, whether the various sulphids have each a definite action or whether they modify one another. There is no question whatever but that when these principles are established a ready-made preparation can be produced, if it has not already been produced, that will not only be equal to the crude product now manufactured on the farm, but far exceeding in efficiency much that is now used, for it is beyond question that according to the accidents of manufacture there is now much variation in the material as applied to our orchards. We want not only a good insecticide, but the best.

Next to the insecticide just mentioned the petroleum oils, or their distillates, have received the largest amount of attention. Our contribution, Bulletin No. 153, has given the most light upon the subject, still agitating our growers, of preventing possible injury to the plant. The efficiency against insects and safety to the plant under many conditions are amply proven in elaborate experiments in half-a-dozen states. While the work already accomplished has been of great value, that which is yet to be done is still more extensive, especially here in California, where we have to do with a crude product, extremely variable in composition. We can obtain from among the products of our various oil districts, or by distillation, almost anything we may desire, and we know that some of these substances are among our cheapest, safest, and most effective insecticides, but with the present lack of knowledge it is almost impossible to recommend anything. In the southern portion of the State especially has this subject been of absorbing interest, almost to the exclusion of other entomological problems. With our efficient mechanical mixing and spraying machinery there should be a great future usefulness for this class of insecticides, but there will not be unless we can learn enough of the essentials to insure the safety of the plants treated.

Fumigation is another insecticide now counted of the first importance which was first made practically successful in California. Several recent studies have added a great deal to our knowledge of this insecticide. Our Bulletin No. 152 gives the most extensive contribution to our knowledge of the amount to use that has yet been presented. At the present time the growers are particularly insistent that further studies be made to improve the certainty of its action. While recognized as the most efficient of all insecticides, under the best conditions it is now too often a failure. One of my assistants goes into the field next week to begin further studies on this subject.

Arsenical insecticides have received more attention than cyanide in the Eastern states, and are a subject of considerable concern in this State. Our Bulletin No. 151 presents precise information upon the character of the paris green found on our market. Bulletin No. 155 brought about a substitution of lead arsenate for paris green to a very large extent in the regions where the latter substance was liable to injure foliage. The danger to foliage is the most important problem in the use of this insecticide. The results of the studies of this Station the last two years at Watsonville will make a notable contribution to this subject. These have not yet been prepared for the printer, but will probably appear before spring. We expect to be able to greatly reduce the cost of this insecticide.

The addition of sulphur to the materials used for spraying purposes for other reasons than the control of mildew is the result of studies of this Station on red spiders, as given in Bulletins Nos. 145 and 154.

Insect control involves numerous other problems than the selection or application of insecticides. In many cases it may be found that insecticides are not applicable. Nearly all the progress in economic entomology has been made in cases where they can be efficiently used. Even in these cases there must be more attention given to the insect than to the insecticides, to make the work effective. Each insect must be studied by itself, and in many cases in each region an insect, like the codling-moth, for instance, may present special problems for study. This division of the subject, however, I will not attempt to discuss in detail, but only mention names of a few of the insects particularly studied and against which conspicuous progress has been made.

The insects toward whose control the most decided progress has been made by studies at the California Station are the codling-moth (Bulletin No. 155), potato-worm (Bulletin No. 135), peachtree borer (Bulletin No. 143), peach-worm (Bulletin No. 144), and hop-aphis (Bulletin No. 160).

Insects injuring crops in California for which other states have made notable advances in their control, are apple-aphis (Idaho Bulletin No. 40), woolly-aphis (Missouri Bulletin No. 35), tent caterpillars (Connecticut Bulletin No. 139 and New York State Bulletin No. 159), Hessian fly (Kentucky Bulletin Nos. 103 and 111, and Missouri Bulletin No. 62), and the squash-bug (New Hampshire Bulletin No. 89). On several of these, studies are now in progress by the California Station. Many other insect pests call imperatively for study.

There never was a time when such an amount of careful, scientific study was given to the practical control of insect pests as during the past few years; never a time when larger financial returns have resulted from this kind of study. In this progress California has taken no backward part, and nowhere, I believe, the need of continuing and expanding this kind of work is more evident than here. Above all, it should be realized that whatever measure of success has been achieved has been due to the application of the scientific method of study. It has been no series of accidents or fortunate discoveries, but the application of hard work, systematically and persistently directed to the discovery of the laws governing the facts of nature. This kind of work, I say, should be supported by the State in a liberal manner; it is a good investment; but in providing for it, there should be full assurance that it be real scientific work. Only those who have the right kind of mental aptitude and such seriousness of purpose that they will take the necessary training to fit themselves for scientific investigation are able to accomplish such research work.

In this paper I have called special attention to the need of work with insecticides. Judging the immediate future by the past, it seems beyond question that the most promising field of study lies in this direction. I do not want to be misunderstood, however, as suggesting the abatement of effort along other lines. I am only predicting that the greatest proceeds from the investment of effort will come from the further working of the fields that are now productive.

In this connection it may not be out of place to say something in regard to the question that has been discussed so often before this Convention: that of the need of parasitic and predaceous insects. Nearly all of the older economic entomologists have expressed themselves as hopeful of securing practical control of insect pests by favoring their natural enemies. There was none more outspoken along these lines than Professor Riley, and no one of his contemporaries made more effort than he to practically carry out this principle. The introduction of the *Vedalia cardinalis* into this State was one of these efforts, which our honored chairman played no small part in bringing to success. Since that time there has been a great deal of effort along similar lines, especially here in California, due to the activity of our chairman, but practically no literature of real scientific value is in existence. It is a matter of regret that the work done in this State along this line has been done without any effort toward the scientific study of the problem. No one has adequate knowledge of exactly what has been accomplished thus far. The literature that does exist shows clearly that the kind of observations and experiments that it is necessary to make in order to speak intelligently on this subject has never been made. No one is safe in estimating how much has been accomplished, nor can he make any true estimate of the future prospects of this line of work. What is needed most now is to have an exhaustive study made to determine the results already secured, and if future work of this nature is to be done provide first of all for a careful, scientific study of the problem, which shall follow through all the work day by day and accumulate data valuable in the prosecution of the work and giving a reliable basis for judging of the results secured.

It would seem that in this State, where we are willing to spend so much for horticultural inspection work and for so many other purposes intended to be in the interest of the grower, we should also provide—we should not be so shortsighted as to fail to provide—for the scientific investigation of these practical problems of insect control.

VICE-PRESIDENT POWER. We will now listen to a paper entitled "The Horticultural Commissioner," by R. P. Cundiff.

THE HORTICULTURAL COMMISSIONER.

By R. P. CUNDIFF, of Riverside.

The rapid development of the horticultural interests of California during the past thirty-five years has never been equaled by any other country. The great area of our State, with its diversity of soils and climate, has made it possible to produce, not only the greatest variety, but the finest and best flavored fruits, easily placing California in the lead in horticulture.

From the "Trade Index" of 1904 we quote the following: Twenty-four states report a fruit crop exceeding $1,000,000 in value, California leading with $21,700,000, New York being second with $10,500,000. Since the above figures were compiled the increase for California has been not less than 15 per cent. As a fruit-producing State, California leads in the following varieties: Oranges, lemons, figs, olives, apricots, pears, prunes, and apples. The orange crop, in the report above referred to, was 28,000 cars from this State. The area devoted to citrus fruit in California is estimated to be about 76,000 acres, while Florida, its only competitor in the United States, has about 26,000 acres.

The grand results achieved by our horticulturists in placing our State in the enviable position it occupies as the greatest in horticulture, have not been attained without most careful and energetic effort.

Aside from careful cultivation, pruning, fertilization, and selection of best varieties, the protection of our orchards from destructive insects and plant diseases has engaged our most intelligent consideration. California was the first State to enact and put in active operation laws designed to protect horticulture against insect pests and plant diseases. Our commerce with many of the oriental and tropical countries, where insect life is abundant and destructive, brought to us some very troublesome and expensive pests. Our first law intended to promote and protect horticulture was enacted in 1881. This law was intended mainly as a quarantine measure, for the purpose of preventing the introduction of dangerous fruit pests from foreign countries. Unfortunately this law was not enacted in time to prevent the establishment of some very serious insect enemies of fruit culture. The law has been amended from time to time as the increasing importance of the fruit industry appeared to demand.

From the cumbersome State Board of Horticulture of nine members who were appointed by the Governor from different districts of the State, we now have an active State Commission of Horticulture, consisting of a State Commissioner and the necessary number of assistants, to properly carry on the great work intrusted to his care.

The State horticultural law provides for the establishment of County Boards of Horticulture, to consist of three members. Such commissioners are authorized to district their counties, appoint inspectors, etc. The appointment of County Boards of Horticulture can only be made upon the request or petition of twenty-five, each of whom must be a resident freeholder and owner of an orchard. Upon such petition being presented to any Board of Supervisors they must appoint a Board of Horticultural Commissioners, as above provided for. Though the law explicitly states that such commissioners shall be qualified to properly perform the duties of such office, it is nevertheless true that in many instances this is absolutely ignored by the appointing power. Unfortunately some of our Boards of Supervisors appear to have but a slight conception of the importance of this office, and in such cases their appointments have generally been political rewards instead of any attempt to place the best and most competent men in these positions. This has resulted, as might be expected in some counties, in bringing the horticultural commissioner into disrepute. Surely an officer whose duty it is to protect and promote the leading industry of our State should be endowed with better qualifications than his mere ability to do politics. The man selected for commissioner should receive his appointment absolutely upon his ability and especial fitness for the office, and entirely independent of any political considerations. In this manner only will it be possible to obtain the best benefits of this most important office. The appointee should be a man of well-known intelligence and ability; if possible, one who has made a sufficient study of entomology to correctly classify such injurious and beneficial insects as he is likely to come in contact with in his locality. He should also have a thorough knowledge of remedies or other methods of combating injurious pests. A knowledge of vegetable pathology is also very important, at least a sufficient acquaintance with the same to be able to correctly diagnose, and apply proper remedies for the cure of such plant diseases as he will be liable to come in contact with. He should be a man of first-class executive ability, who at all times will be able to secure the greatest benefits to horticulture in his locality, at a minimum expense.

The horticultural law invests the commissioner with powers, seemingly arbitrary, regarding the eradication of insect pests and plant diseases. This power should never be used in a haughty or unjust manner. The unwise use of this authority has in many instances made enemies for the horticultural commissioner, which by a reasonable amount of diplomacy could have been averted. I should, however, not advise a weak or vacillating policy when it comes to an individual as against a community interest.

In addition to the information gained by close observation and experience, the various bulletins, issued from time to time by the U. S. Department of Agriculture, should receive his most careful attention. The reports of the entomological and pathological divisions should engage his especial consideration. To be an efficient horticultural commissioner, as in any other business or profession, requires an especial fondness for the work. This must be supplemented by energetic study and close observation. In this way only will he be able to give prompt and reliable information to those seeking his advice.

This is the age of specialization. We would advise against the commissioner distributing his energies over too wide a range of subjects, lest he become superficial in many and proficient in none. If the commissioner is able to successfully cope with the insect problem and plant diseases of his locality he will have accomplished all that should reasonably be expected. Reliable information should at all times be available from our State horticultural department on such subjects as cultivating, fertilizing, pruning, etc. The advantages of a competent horticultural commission in any county where fruit-growing is engaged in to any extent are many and important.

The enemies of fruit culture in the way of destructive insects and plant diseases are in some localities of our State already a serious drain upon the income of the orchardist. The best and most economical methods of combating the pests already established, as well as a determined effort to prevent the introduction of new ones into his locality, should receive the earnest attention of the commissioner. Many instances could be cited where an active and successful County Board of Horticulture has induced the investment of capital in orchard property. The fact that a county is sufficiently interested in horticulture to maintain an energetic, competent horticultural commission should be an inducement to the careful investor. He would naturally infer that such a condition was to a great extent a safeguard against the introduction of insect pests and plant diseases, and that such pests as might already be established would, if possible, be held under control.

To prevent, as far as possible, the appointment of incompetent persons as horticultural commissioners we believe the present horticultural law should be amended as follows: That no appointment be made or application considered by any Board of Supervisors, until such applicant shall have filed with such board a certificate as to his qualifications to properly perform the duties of such office, duly signed by the State Horticultural Commissioner. The term of such appointment to be for four years, unless removed for cause, after charges are preferred and proven. We believe such an amendment would practically eliminate partisan politics, and otherwise greatly improve the personnel and efficiency of our horticultural commissions.

VICE-PRESIDENT POWER. "Root Stocks for Grafting," by A. D. Bishop.

ROOT STOCKS FOR GRAFTING.

By A. D. BISHOP, of Orange.

The question as to whether we are giving sufficient attention to the stocks on which we are growing our orchards is ever presenting itself to my mind, and the answer, based on experience and observation, is always in the negative, although relating mainly to the business of the south and the citrus industry, as that is the work in which I am engaged.

To those who know more than I do and who practice all that I suggest, these lines are not addressed, but to those people who are continually doing things that were done twenty years ago which experience has proven impossible of success, a few hints may be of service. We often read flaring advertisements with extended head lines setting forth the great success of individual work under especially favorable conditions and circumstances as though this success could be achieved by all, and we fail to realize that for every special success there are hundreds of whole or partial failures. While such statements are unquestionably true in the instances cited, they are wrong in the fact that they are misleading, and while we seek to induce the people of the East to come and stay with us and to divide our holdings with them, or have them improve the vast territory yet unused, we should wish them to be contented, and to be contented they must be successful, and to that end start right. It is for this reason that I am making the following suggestions.

As showing the lack of judgment evinced even by people of long residence among us, it is not uncommon to see orchards of one variety removed and another planted, until practically the same land has been replanted three or four times. And when they ask you the best way to start a walnut grove and you tell them by all means to plant a nut of the American black or giant California in the place where the tree is to grow, and when of proper size, graft with a scion cut from a bearing tree producing the character of nut desired that always produced a plentiful supply of staminate blossoms and ripened its pollen at a time when the pistillate blossom was ready for fertilization, you are met with, "Oh, well, I know that is correct; but I am in a hurry, I can not wait for that. I want trees now." And so the planter buys what he can find; possibly none that exactly suit; and when they commence to bear, they produce all kinds of fruit, from good to bad, while some produce practically nothing.

A few years ago, more than fifty per cent of the hybrid walnuts were afflicted with black knot at the surface of the ground before they had been planted in orchard three years. Whether or not this was caused by injury in cultivating, as many contended, it is not as prevalent now as in the past. The transplanting of the walnut causes a greater shock to the tree than to most other deciduous trees, and I believe more so when on the black walnut root.

We have the annual spectacle of people planting grape cuttings in a territory where the mysterious California vine disease is prevalent. These show signs of the disease by the end of the first season, and at the end of the third are practically all dead, without having produced a bunch of grapes; when it is a well-known fact that there are varieties immune to the disease and that all varieties grafted on resistant roots, while not immune, will be prolonged to yield some degree of profit.

It is a peculiar thing that none of us ever contemplate any additional plantings until suddenly seized with an inspiration to plant some special varieties, and still more peculiar that many others are afflicted with the same inspiration about the same time, which results in a great scramble for trees; but if you suggest to a man that it is not safe to plant orange or lemon budded on sweet seedling roots, and especially on land of the character which he has in contemplation, owing to the liability of gum disease, he tells you, "This is all I can get, and as I wish to receive some return for this work myself, I can not wait." He should know, if he has been a resident for only a few years, that by the second year he will have commenced to doctor some at the ground's surface; the next he will begin to replace, and at the tenth year a large percentage will have been replaced; and if attended to faithfully some will have been replaced at least three times, and I have witnessed the replanting of more than ten per cent at the beginning of the second year. Now, if on the day the orchard was started he had planted seed of the wild or bitter orange of the West Indies, commonly called sour-stock, and grown roots on which to bud, he would surely have had a more profitable orchard at the end of the tenth year.

I find in the published report of a Farmers' Institute held in the City of Santa Ana in 1892, that A. D. Bishop recommended the use of sour-stock as a preventive of gum disease. It was a theory with me at that time, because of the natural condition under which this stock grew and the not entirely dissimilar condition which we create by irrigation. I consider it now to have become a well-proven fact, and while gum disease is much more destructive on some classes of soil than others, it is present everywhere and on the increase. Some twenty-five years ago it was unknown, and we may well ask ourselves if it is unreasonable to expect citrus trees to develop troublesome and destructive diseases, since that is the common history of many agricultural plants, both annual and perennial, when grown for a considerable period in the same field or territory.

Nurserymen, like people engaged in other commercial enterprises, are working for the profit that is in the business, and while striving to supply the public with what they demand, they are growing trees on such roots as will insure the largest and best looking trees in the shortest possible time, and for that reason a large percentage of the stone fruit orchards are of the peach, a root of short life and full of trouble in its susceptibility to attacks from insects and diseases.

If a part of the effort now being expended in the creation of new varieties were devoted to the creation of stocks immune to any serious troubles that affect the industry, it would undoubtedly result in lasting benefit.

The great advantage in using sour-stock is in its magnificent deep-growing root system, its immunity from gum disease in the top grown upon it, provided it is budded high enough to prevent its more tender bark from coming in contact with the ground, and I have yet to find the first block of nursery stock that conforms to that condition, all being budded so low as to lose all advantage from the resistant stock, probably because the grower would have been compelled to keep the stock a year longer to have gotten them of proper size at 12 and 16 inches from the ground.

VICE-PRESIDENT POWER. "Barring Out Suspected Stock," by S. A. Pease.

BARRING OUT SUSPECTED STOCK.

By S. A. PEASE, of San Bernardino.

As all well-posted horticulturists know, all of our very numerous bad fruit tree pests have been shipped into our State on nursery stock of various kinds.

We, of California, are noted for being in the front rank in the matter of inspection and quarantine. And yet it should be apparent to all that something has been awry with our methods, else we would not to-day be taxed with such a long list of bad fruit pests.

The white scale (*Icerya purchasi*) was introduced into California from Australia on acacia plants in 1868 by Mr. George Gorden of Menlo Park. From there it spread all over the State and cost an immense amount of money to fight it prior to the introduction of its natural enemy, *Vedalia cardinalis*.

The red scale (*Aspidiotus aurantii*) was first introduced into California on six lemon trees from Australia by Don Mateo Keller of Los Angeles. When we contemplate the immense amount of damage done by this pest to our citrus groves and the hundreds of thousands of dollars that have been spent in fighting it, surely we realize what a great thing it would have been if those little lemon trees had been dropped into the ocean, or burned, or at least quarantined until the trees were proven to be perfectly clean.

The purple scale (*Mytilaspis citricola*) was first introduced into the United States on some lemons shipped into Jacksonville, Florida, from Bermuda in 1855. This was so long ago and the damage so great in Florida that it would seem to the average person that every care would have been taken to keep it out of our State. It would seem as though nurserymen interested in Florida stock would wish *not* to have it spread. The facts are that certain nurserymen who raised and budded citrus trees in Florida shipped a great many carloads into this State. Many of the trees were covered with the purple scale. When *our* inspectors quarantined the infested trees, burned some, removed the foliage from many, and brushed the trunks, the said nurserymen declared that they were unfairly treated, because this scale would not live in Southern California. And, further, they said that if the trees were allowed to be planted with the scale on them they would pay five dollars for every scale found alive at the end of two years. Fortunately for us, in our immediate vicinity these "fairy tales" had no effect; and we have no purple scale in our county to-day. But these same nurserymen turned their shipments in another direction, where they were allowed to plant their trees without let or hindrance. What was the result? A friend of mine who lives in that locality told me a short time since that he would like to show me a block of eight hundred acres of a new kind of fruit, a deciduous lemon. I asked him what made the trees shed their leaves, and he answered, "Purple scale."

It has cost California millions of dollars to learn some of these lessons and it would appear that the end is not yet.

The red spider of the citrus tree (*Tetranychus mytilaspidis*) was shipped into California on trees from Florida, as were also the rust mite and the silver mite of the lemon, and the Florida wax scale. We haven't them all yet, and are we to continue until we have all of these known money wasters?

The red spider of the deciduous tree (*Bryobia praetensis*) was first heard of by us on deciduous orchards in the northern part of our State, where the earlier method was to fight them by filling the air through the orchard on damp or foggy days with sulphur thrown through a broadcast seeder; and yet, after reading all this, deciduous nursery trees were shipped south into our county, where the uneducated eyes of our inspectors did not discover the millions of eggs at the base of twigs and limbs on the trees. So, Southern California was set to fighting this pest.

The "San José" scale (*Aspidiotus perniciosus*) came from northern China and was first introduced into Santa Clara County by James Lick in 1870. Since that time, it has spread all over the State of California, and the United States as well. The history of the spread of this scale is so well known that it needs no further mention from me.

In June, 1891, a cargo of orange trees arrived at San Pedro from the South Sea Islands. Upon inspection, these trees revealed the presence of eight different kinds of scale insects. Among them was the mining scale, which it was found impossible to kill without killing the trees. Finally, by an order of the court this whole cargo was burned on March 29 of the following year.

At that time, in the report of Alexander Craw, he recommended that the quarantine laws be further amended, giving the officers more definite powers, as delays in the enforcement of laws is often dangerous (State Horticultural Report, 1892, page 453). In the same report for 1893, page 291, Mr. Craw says, "An ounce of prevention is worth a pound of cure," and further on he says, "It will be readily appreciated here that eternal vigilance is the price of success in the fruit industry, and if we would reap that just reward for which we labor we must take effective measures to keep out those destructive agencies which we have not got, and stamp out by the best means those which we have."

Among the destructive insects which so far are not introduced into our State, I will mention the gypsy moth (*Porthetria dispar*), the white fly (*Aleyrodes citri*), and the Mexican orange-maggot (*Trypeta ludens*).

In our own county we have no purple scale, Glover scale, wax scale, rust mite, silver mite, nor phylloxera of the grape. It is patent to any one who has had experience in combating scale insects that we do not wish to acquire any more.

To illustrate how our people feel on this subject, I will relate a little incident. A certain nurseryman was very anxious to ship orange trees into one of our districts which practically has no pests. These orange trees were infested with the Florida red spider (*Tetranychus mytilaspidis*). The man insisted that he had a right to ship his trees anywhere that he could find a market for them. A number of the wide-awake growers in that district said that if necessary they would send a representative to where the trees were and purchase them and burn them there. It was not necessary, and the trees were not shipped into their district.

Many of the worst insect pests are so minute that they are very apt to be overlooked by the ordinary inspector, hence we have an ordinance quarantining very strictly against nursery stock from districts known to be infested with insect pests not prevalent in our county.

To illustrate, again, we have over sixteen thousand acres of grape vineyards in our county, and as yet we have no phylloxera. If we admit grapevines from a locality known to be infested with that pest it is patent to any one who is acquainted with the pest history of this State that it would only be a question of time, and a very short time, perhaps, when that worst of all grapevine pests would find its way into our extensive vineyards and the consequent damage would be greater than any nurseryman or combination of them could remunerate. Past experience has shown us "how great a matter a little fire kindleth."

We quarantine very strictly against any possibility of introducing the "peach yellows." Why should we be less careful about acquiring other known injurious pests?

And in the matter of local quarantine inside our State, would not purple scale, or phylloxera, or long scale, or any other scale, be just as damaging and just as costly if introduced from an adjoining county or an adjoining district as it would be if imported from another State or country?

We are spending many thousands of dollars annually in our county fighting fruit pests, and we will not sit down peacefully and allow our county to be flooded with the whole list of pests, simply because some avaricious men have stock that they wish to dispose of for money, whether said stock be clean or infested.

Experience has shown conclusively that if any one has infested nursery stock he is very apt to reduce the price on such stock in order that he may catch the unwary and dispose of his stock, insects and all. That kind of business I do not excuse, as I have heard many do, by calling it human nature; I simply call it avarice.

I could cite cases where individuals have told ranchers that they could dodge our ordinance by shipping stock under a false name. Is this right, or just, or honest? All we wish to do in these matters is to use all honorable means to avoid past mistakes and not add to our already long list of burdensome insects.

We have no desire to quarrel with the honest nurseryman. His interests and ours are alike jeopardized by the increase of these pests; but we do feel that the best interests of every part of California should actuate their motives as well as those of the Horticultural Commissioners. We can work in harmony and still aim to avoid the expensive mistakes of past years.

(At this time an adjournment was taken until 9:30 A. M. to-morrow morning.)

PROCEEDINGS OF THIRD DAY.

THURSDAY, December 6, 1906.

The Convention was called to order at 9:30 A. M. President Cooper in the chair.

MR. JOHN MARKLEY. If I am in order I would like to offer a resolution.

Resolved, That the coöperation of the press of our city and State, and of organizations and all that have the best interests of our city and State at heart, be and is hereby asked.

Resolved, That the State Legislature, to convene January, 1907, be and it is hereby requested to give early and immediate consideration to the needs of permanent and modern water front improvements in ports under the jurisdiction of State authorities.

Resolved, That a bond issue be recommended for State water front improvements, approximating a total of twenty-five million dollars ($25,000,000), to be apportioned equitably to the different harbors of the State, including San Francisco, Oakland, San Diego, San Pedro, and Eureka, said amount to be expended over a period of ten years, one tenth each year, and said bonds to be made payable in fifty (50) years, and bear interest at the rate of four per cent (4%) per annum.

The Legislature is to appropriate a sum not to exceed fifty thousand dollars ($50,000) for preliminary engineers' reports, recommendations, plans, specifications, and estimates.

The Governor shall appoint a special board, consisting of five commissioners, to inaugurate and carry on the work and supervise the expenditure of funds. The work undertaken at San Francisco to be generally but not specifically as follows:

(*a*) To generally construct seawalls around the water front of San Francisco. To fill in seawall lots adjacent thereto, particularly to fill in seawall lots between Section 14 at the Mail Dock and northerly to the foot of Main street.

(*b*) To construct generally permanent modern stone docks and piers along the said water front and improve Islais and Indian basins and erect modern and permanent docks therein, whereby generally the rapid transfer and handling of cargoes can be facilitated.

(*c*) To coöperate with existing and projected railroads, by the construction and completion of a permanent and continuous system of belt line railroad, operated around the water front of San Francisco, being an extension of the present system, with spur tracks on all piers and docks to facilitate the loading and unloading of cargoes to and from railroads, factories, and business houses. Said belt line to cross Market and Channel streets by means of subways, to be constructed for that purpose.

Resolved, That in view of the railroad developments on the southeastern end of the peninsula of San Francisco, the California congressional delegation at Washington be asked to further the plan of dredging the waters of San Francisco Bay, particularly that portion known as Mission Bay, as suggested by United States Customs Surveyor Woodward, now in Washington, and that our delegation at Washington take the necessary steps to include in the Rivers and Harbors Bill an appropriation of two million dollars ($2,000,000) or more for said purpose.

MR. JUDD. I second the resolution.

PRESIDENT COOPER. It will be referred to the Committee on Resolutions. The first paper this morning is entitled "Horticultural Uses of the University Farm," by Prof. E. J. Wickson.

HORTICULTURAL USES OF THE UNIVERSITY FARM.

By PROF. E. J. WICKSON, of Berkeley.

By the munificence of the State, through the Legislature of 1905, the University of California has been provided with about 780 acres of first-class valley land, with deep, rich soil, easily tilled and fully adapted, as the law requires, to produce as many as possible of the crops which can be grown in California. It is upon an established irrigation system and has water rights for its full acreage. It is situated at the junction of two overland routes, within half an hour by rail of the State Capitol, and can be reached by five minutes' walk from the railway station at Davisville, in Yolo County. It is probably the most valuable and suitable for demonstration of the best that can be done in agriculture and for instruction therein of all the farms owned and used by the agricultural colleges of the United States for educational purposes.

By the munificence of the late Mr. M. Theodore Kearney, the University of California will, in due time, come into possession of another magnificent piece of land of about 5,400 acres near Fresno. According to the desire of the donor, this land will also be used for agricultural education, research, and experimentation. The fact that Mr. Kearney should devise this land for these purposes after the State, through its commission for the selection of a University Farm, had declined to accept a part of it to satisfy the requirements of the specific law under which they acted, is very significant of two moving forces in his mind: first, that he would not be actuated by the feeling that a slight had been put upon his proffered gift; second, that he was fully convinced that one farm, no matter how great and good, would not adequately meet the urgent demand in this great and varied State for practical instruction and scientific investigation in agriculture. Therefore, his gift stands for this declaration of his dying faith: whatever the State may provide and maintain for this training and research upon which its future development and prosperity depend, there is ample opportunity and demand that much more shall be done by individual gift and bequest. Thus the University comes into ownership of two grand agricultural properties to be strictly used for agricultural education in its various branches.

This rich inheritance which comes to the College of Agriculture of the University of California must be taken as evidence of full recognition and appreciation of two things: First, the research work, and the popular presentation of its results, by Professor Hilgard and his staff during the last third of a century has convinced the people of California that the fullest knowledge of California conditions of climate, soils, and culture must be had for intelligent and profitable pursuit of the industries which are based upon them. Second, that the equipment and facilities of the College of Agriculture for teaching the practical arts in accordance with the scientific demonstration of local conditions were pitiably meager and inadequate. Hence arose the popular demand that the College should undertake instruction in California farm practice on much broader lines than it has ever undertaken hitherto, and that it should do this under actual farming conditions on an easily accessible and widely representative farm and should adapt such instruction to the needs and requirements of those who intend to secure a livelihood directly from the soil. That the Legislature from the popular demand, and Mr. Kearney from his own convictions, should place all this value in the hands of the College of Agriculture is a complete demonstration that the foundation laid by it in agricultural science was recognized as sound and enduring, and that the men who had given their lives hitherto to the building of the foundation could best direct the expansion on the practical side of instruction so that agriculture known to be practicable under California conditions should be faithfully and accurately taught. Thus the recent State law indorsed by Mr. Kearney's magnificent gift becomes an incontrovertible decision that agricultural research and instruction shall be henceforth entrusted to the University of California in accordance with the organic act which brought this institution into existence nearly forty years ago.

I have indulged in this general statement in the hope of contributing to a clearer popular conception of the relation of things. The horticultural uses of the University Farm are naturally of particular concern to us as we assemble as representatives of the fruit-growing industries of the State. As is generally known, the equipment and uses of the farm will begin along the lines of the animal industries and general farming. This is a proper recognition of the live stock interests as prime movers in securing the farm for the University, and it is justified also by the fact that those engaged in the animal industries and general farming, as a whole, are relatively less advanced in understanding their best agencies and methods than are those in the fruit industries, although we have a number of individuals who have pushed their live stock work in California to the point of national leadership. To meet, then, this popular demand and opportunity to elevate general farming and stock-growing in California, to better serve individual prosperty and the advancement of the State, the balance of the appropriation of 1905 will be used, so far as it will go, in buildings and equipment along this line. The horticultural phases of equipment and instruction will, however, immediately follow and it is interesting to outline some of them:

First—The University Farm will have standard orchards and vineyards, with all desirable kinds of fruit and varieties thereof, which shall be grown true to name and shall serve as a source of material for wide pomological studies, as well as court of last resort for all questions of identification and nomenclature. It will also be a source of cuttings and scions necessary to test these questions locally in various parts of the State, whenever issues arise.

Second—Aside from these standard collections there will be commercial orchards and vineyards, with enough of each variety to demonstrate the best methods of handling in actual practice the trees and vines and the fruits which they bear. There will be, at proper times of the year, announcements that any one interested can go to the farm to learn pruning, spraying, fumigating, irrigation, and all other practical arts of culture, and other times when fruit picking, packing, drying, etc., will be demonstrated.

Third—There will be a full outfit of buildings for the different methods of fruit preservation with artificial agencies, and for the manufacture of fruit products, such as fruit drier and cannery, winery and cellar, distillery and other equipment. All these operations will be actually performed and taught.

Fourth—Plantations of small fruits will also be maintained for observation of varieties and for instruction in culture and handling of products.

Fifth—The growth of vegetables will be undertaken on a commercial scale, both under rainfall and irrigation, and variety tests will also be constantly in progress. Forcing operations will be provided for.

Sixth—Methods of propagation of trees and plants will naturally be constantly pursued for instructional purposes and as introductory to nursery practice with all classes of growths—ornamentals, fruit trees and vines, and forestry plantings.

Seventh—Plant protection, to be secured by an understanding of the various injurious insects and plant diseases and the best ways to cope with them or to avoid them, will be amply demonstrated and inculcated.

Eighth—In all buildings and appliances for horticultural work, as for other equipment of the farm, it is intended to regulate design and expenditure, so far as possible, so that the pupil shall work in buildings and use tools and machines such as he can construct and purchase for his own use afterwards, and not in show buildings and with gilded tools. Thus he can return from the instruction with sketches and lists of these, to use in making up his own home outfit. Although, of course, large buildings will be required for assembly and class-room purposes, the working parts of the farm will be, so far as possible, instructive, because susceptible of reproduction for actual use.

Ninth—There will be going on on the farm constantly, so far as funds will permit, research and experiment work in pomology, plant breeding, plant protection from pests and diseases, all of which will constitute horticultural uses of the farm and be effective not only in advanced instruction, but in the promotion of horticultural science.

Of course all these things, and others like them which will undoubtedly be provided for as they arise, are not new to University instruction in agriculture. Many of them are now taught in Berkeley, but they will be taught from a different point of view and with fuller demonstration on the farm. We shall be enabled to do more because possessed of our own outfit. We can not forget, however, how we have been helped hitherto by the generous coöperation in horticultural investigation of such organizations as the Pajaro Valley Orchardists' Association and many other groups of progressive fruit-growers. We are deeply gratified, however, that we shall be able to do so much more for the horticulture of the State in the future than we have heretofore.

PRESIDENT COOPER. The next paper is "The Water Supply of the Sierra Nevada Mountains," by John Tuohy.

MR. TUOHY. Mr. Chairman, as this hall is large and I am not in very good voice, I will ask that the Secretary read my paper.

(The following paper was then read by the Secretary:)

THE WATER SUPPLY OF THE SIERRA NEVADA MOUNTAINS.

By JOHN TUOHY, of Tulare.

Mr. President, Ladies and Gentlemen: In undertaking to address you on so important a subject to the fruit-growers of the San Joaquin Valley as is the water supply of the Sierra Nevada Mountains, I assure you that none of you have graver doubts of my ability to do justice to the subject than I have myself.

What I have to say as to the streams of the Sierra Nevada Mountains, and of their utility to the fruit-growers of the State, is from contact and experience more than from scientific investigation and study.

I arrived in California early in 1850, and, like nine tenths of new arrivals in those days, went to the mines in the Sierra Nevada Mountains, thinking like most others that gold mining and incidental industries were the only possible ones for a soil, a climate, and a geographical location such as pertain to this State. My mining life of eight years was spent in Tuolumne and Calaveras counties. Then and since that time I have had ample opportunities and more ample time as a miner, a stock-raiser, and a fruit-grower, to reconsider my first verdant views, and to know that for diversity of profitable industries, rich and productive soil, and healthful, delightful climatic conditions, its great mineral productions equaling the best of any State in our Union, being a leading one of the minor ones, California leads the United States.

I have heard at various times enthusiastic admirers of California call it the Italy of America. It is less than two years since I visited Italy, and although I was there only a short time, it was, however, long enough for me to see that to call California the Italy of America is a misnomer. In the size and safety of its harbors, in its geographical position, in the productiveness of its soil, and in the salubrity of its climate, California has no superior. One may say Italy is the California of Europe; it is as good a California as they can have; but there is only one California, and that is ours where we live; and the tillers of the soil, the general farmer, the vineyardist, and the orchardist have the cream of the land, in which are the loveliest homes a rural population can have for dwelling.

I heard a prominent lecturer call Lake Como the "shrine of the universe," but I consider him a false teacher, and worship not at that shrine. I have visited Lake Tahoe, one of the brightest gems of our Sierra Nevada Mountains. For picturesque grandeur of setting, for charming tributaries, for depth and intensity of coloring, and for sharp lines of coloring according to its depth, Lake Tahoe has no peer. Even in conditions beautiful, impressive, and grand, as well as in those industrial and habitable, we have our lakes, our Yosemite, our Kings River Cañon, our Sequoia gigantea. If I worship at one of nature's shrines, whether lake, mountain, rock, or tree, I will worship at home, where I have idols unsurpassed in such lines. Ladies and gentlemen, I have lived nearly fifty-seven years in California, and speak of it from heartfelt convictions. It is my home, and I think it the loveliest place on earth. I ask your patience for the digression.

In discussing the Sierra Nevada Mountains and their water supply, I take it for granted that the cause which produces the supply should be given due consideration.

The Sierra Nevada Mountains extend from Tejon Pass on the south well up to the Oregon line on the north. It is the highest range of mountains in the United States, and has on the west side the best supply of streams for utilitarian purposes of any range of equal extent therein. How is this accounted for? How can one extent of catchment area supply a greater amount of run-off than another of equal or greater extent? Does it? Climatic observations, now of many years in California, show that our moisture-laden clouds come from the west and northwest. That as they pass through the rarefied and cool atmosphere pertaining to mountain ranges, the moisture acquired under warmer conditions condenses and precipitates; but the lower the range the less the atmosphere is cooled, and the less precipitation it causes. The greatest precipitation, however, will be on the side of the mountain which the storm first strikes. It is this atmospheric phenomenon which causes a greater precipitation on the mountain than in the valley, and a greater fall on the high mountains than on the low ones, and greater on the side the storm first strikes than on the opposite side. This is established by the rainfall records, which show that the rainfall and run-off on the west side of the Coast Range, and on the west side of the Sierra Nevadas—the sides the storm strikes first—is greatly in excess of that on the east sides of those ranges, and greatly in excess of the rainfall in the intervening valleys. For instance, the survey and records show that Kern River, on the east side of the mountains, has a catchment rainfall area of 2,345 square miles and a mean discharge of 734 cubic second feet, whilst Kings River, on the west side, with a catchment area of but 1,781 square miles, has a mean discharge of 1,781 cubic second feet. From a comparison, then, of the drainage area and the discharge of each river, it appears that Kings River on the west side has, to the square mile of catchment, a rainfall practically three times as great as that of Kern on the east side of the ridge, and thus, too, showing the moisture-depleting conditions of the mountainside the storm first strikes. Kern River has on its west side all the mountain conditions as to elevation that Kings River has, and has besides an almost equally elevated range of mountains on its east side.

A comparison of Truckee River on the east side of the mountains, and the American on the west, drainage area and discharge of each river considered, will show about the same difference of rainfall between them.

I will now speak of the irrigable lands of the San Joaquin Valley. We are here not far from its center, and we see before us object lessons in its wonderful productiveness. Those of us who were here in the early years of its settlement know how unattractive its condition was then, and those of us who have survived until the present and who have the privilege of attending this Convention can see the transformation. There is no part of our State more prosperous than this is, and this in a measure can be said of the whole San Joaquin Valley from the Cosumnes River on its north boundary to Tejon Pass on its south. In those early days the valley had the same fertile soil and salubrious climate it still has, but it lacked its present intelligent population. Then in this locality, owing to the distance to market, and the cost of getting products there, stock-raising was the only industry to be engaged in. Besides, the climatic conditions were unfavorable. Rain in amount for cultivated crops was insufficient.

About that time the overflow of population from the northern portion of the State began coming in. But few could go into stock-raising, and if any could the country was already stocked beyond its grazing capacity. It was realized that if homes were made here—I am speaking now of Kings County, but the principle applies to the whole valley—

other crops must be raised, and cultivated crops required a greater amount of moisture than the average annual rainfall.

The early settlers in this section had many trying conditions to contend with. The law requiring them to build costly fences to protect their crops from roving and numerous herds of stock was against their best interests and retarded improvement of the land. The cattlemen with one accord opposed the repeal of this law, contending that stock-raising was all the land was suitable for, and that it was valueless for other purposes. These conditions bore hard on the poor pioneer settlers, who claimed that the land then used for roaming herds of stock could, with proper irrigation by means of the waters of Kings River running waste from the mountains, be utilized for homes for American families, who could live in comfort on twenty acres properly irrigated and tilled, whilst twenty acres were necessary under old conditions for the maintenance of one head of cattle.

For several years the contest was bitter, but right prevailed, by the settlers electing to the State Senate the Hon. Tipton Lindsay, a man representing their own principles, and the fence law was repealed, and a "no fence law" was enacted. In other words, stockmen became liable for damage done by their predatory stock.

Another trial with which the early settlers had to struggle was their contention with the Southern Pacific Railroad Company. It is unnecessary to go into the details of this sad and bitter experience, but I know of no section where the settlers suffered such tribulations for their homes. One thing they have demonstrated: that land, be it ever so rich in this valley, as in the valley of the Nile, without water is unfit for homes; with water in sufficient quantity it is marvelously productive.

In this paper I do not propose to name the quantity of water that is sufficient for crops in this valley. That depends upon the character of the crop and the fertility and the amount of cultivation of the soil in which the crop is grown. One thing is certain: our experience proves to us that from the climatic conditions of this valley the waters of the west slope of the Sierra Nevada Mountains are of vital importance to the fruit-grower.

There are some things pertaining to the San Joaquin Valley I assume to be granted, at least by the audience I now address: that we have a salubrious, healthful climate, and a rich and fertile soil; that these are conditions, but not all, that go to make desirable homes; that intensive farming is an essential industry in supporting the largest population. These claims I assume are granted.

Of farming industries which can be successfully and profitably carried on in our valley, a leading one is fruit culture, citrus and deciduous, and all the conditions requisite to fruit-growing pertain to our soil and climate, except one—a lack of sufficient rainfall on the lands best suited therefor. We do not count this dearth of rainfall as altogether a calamity to the fruit-grower. If the natural rainfall is not sufficient to perfect his crops the waters of our Sierra streams are ample to meet all deficiency, and has this advantage over the rainfall: it can be applied at the time the crop most needs it and can best stimulate its growth and maturity. The rainfall can not be gauged to meet such requirements.

Happily the greatest stream flow is during the months the crops most require it. It is therefore conclusive that the streams of the Sierra Nevada Mountains which supply so readily and so amply the rainfall deficiency, are of vital importance to the fruit-growers of this valley.

I know the sufficiency of moisture for the best crop yield, and the sufficiency of discharge of our streams for proper and scientific irrigation of all our valley lands, are debatable subjects, into which I do not propose to enter.

William Ham. Hall, for several years State Engineer, and whose physical data on the subject is a most valuable work of reference, and also General Alexander, have both carefully investigated the subject and declare that the discharge of our streams is, with proper application and cultivation, ample for any deficiency of rainfall for all the lands of the San Joaquin Valley, and for all of the crops that can be grown thereon.

Careful and continuous study and investigation of the amount of moisture good crops, of all kinds, have received, should be taken as determining the amount of moisture requirements of such crops. These investigations are changing the views of many of us on the duty of water.

Successive years of carefully kept data show the rainfall from the south to the north end of this valley, and the discharge of every stream therein. The amount of that discharge which can be profitably used, which will include the amount that can be impounded, supplemented by the amount of the underground flow, which is vast, should go far in determining the problem of crop requirements in irrigation.

Observation and experience have proven that the amount of irrigation water required depends much on the crop, the time of its maturity, and the amount of rainfall in that locality.

The rainfall records of the Weather Bureau, kept carefully for many years, show that the average seasonal rainfall at Bakersfield is but little, if any, in excess of 6 inches; at Hanford, 11 inches; at Stockton, in excess of 16 inches; at Sacramento, 22 inches; and at Redding, 36.11 inches, in twenty-six years. Hence the healthful growth of trees at Hanford will not require so much irrigation as at

Bakersfield; will need less at Stockton, and still less at Redding; but although the seasonal rainfall at Redding may be sufficient for the healthful growth of trees and fruit, if the precipitation is not in sufficient amount at the time the health of the crop requires it, irrigation must be had to get profitable results. So that in the San Joaquin and Sacramento valleys it is of inestimable value to the fruit-growers therein to have the streams of our Sierra Nevada Mountains from which to draw on for a sufficiency of moisture for their fruit crops, when the rainfall is deficient or inopportune.

It may not be out of place for me, before closing, to say something on the conditions that maintain and regulate the flow of the streams so beneficial to us.

I have heard it asserted that forests produce rain, but this I have been unable to verify by any observations of my own, or by any good authority on the subject. It requires about 24 seasonal inches of rain to produce a forest growth, but it also requires a climatic condition, and not the effect of forest growth, to produce that amount of precipitation. Atmospheric conditions in the San Joaquin Valley pertain to a certain elevation on our mountains, where moisture conditions favor and produce a forest growth. Frequently there are passes in mountain ridges through which currents of moisture-laden clouds are drawn, and it is noticed that in the lines of these currents a greater amount of precipitation falls and more forest grows than does on either side of the line of current.

It is now fully ascertained that forests conserve and regulate the stream flow. The dead foliage of the forest, the amount of undergrowth, and the loose, absorbent character of the soil underlying the fallen foliage, prevent any rapid run-off of the rainfall, retaining it for a more gradual outflow through the soil. In this way the direct discharge of our streams is conserved, and the underground water supply, now known to be very extensive, is replenished and maintained.

A very interesting article on the "Relation of Forest to Stream Flow" is given in the Year Book of the U. S. Department of Agriculture for 1903.

I will assume now that we all agree upon the vital importance of the stream flow to the fruit-growers of this valley, and that we also agree, if we are to get the greatest benefit of our rainfall, that the discharge of our streams must be regulated and conserved, and that this is best done by our forests, and can not in any other way be done as well, and it can not be denied that the preservation of the forests is of primal importance.

The necessity of forest preservation was recognized by some of our progressive farmers some years ago, before Kings County had an existence, or fruit-growing was the great industry it now is. In 1890 Tulare Grange, Patrons of Husbandry, had under consideration the subject of forest preservation for the hoarding of stream flow. By resolution a convention of delegates from the several counties of the valley was called to meet in Fresno. The convention was held, Hon. Tipton Lindsay representing Tulare Grange. The subject of forest preservation and stream flow was discussed, and a petition was prepared and sent to the Secretary of the Interior praying for a withdrawal of our Sierra forests from further sale. The petition was given very full consideration, and Congress passed an Act authorizing the President to withdraw the forest. The President issued his proclamation therefor, and the Sierra Forest Reservation was duly established.

About this time very much of our best forest land was being bought by syndicates and speculators through dummy locators, and in a short space of time all of it would have passed into private hands had it not been for the timely action of the Fresno convention. As it was, nearly all of the best *Sequoia gigantea*, the grandest tree the world has known, were in the hands of private ownership, with the exception of what is known as the Giant Forest, then claimed by a colony of communists known as the Kaweah Colony, and one township on the south fork of the Kaweah River not then on the market, as the survey had not been accepted.

Speculators were then making every exertion to have the survey of this township accepted and the timber sold. Numerous parties of them had been on the land and selected the portions they wanted, and they had their agents at Washington who would telegraph them when the survey was accepted and the order of sale made; on receipt of which information, their application for the land would be filed at the United States Land Office in Visalia. This scheme would in all probability have been successful had not a few men in Visalia, the Hon. Tipton Lindsay, Major George Stewart, Mr. F. J. Walker, and the writer, being cognizant of the facts, and desirous of having the grand old trees in that township preserved for posterity and saved from the vandal ax of the lumberman, reported the conditions to the Secretary of the Interior, who had his agent here at the time investigating the merits of the claims of the Kaweah colonists to the Giant Forest.

They also prepared a bill, setting aside two townships for a Sequoia National Park: the township before mentioned, and the one east of it. This bill, with the statement of all the facts, was sent to our then Representative, General Vandever, who presented the case to the Committee on Public Lands. The result was the bill passed, but it took in six townships, including the Giant Forest, the presumption being that the Kaweah Colony claim on the latter was not such as the law provided for.

Another and a smaller reservation of sequoias was made at the same time, to be known as the General Grant Park. It consists of four sections of beautiful sequoias, and is northwest of the larger park.

The next season, 1891, and every season since, a company of United States cavalry has been in charge of the parks.

While the withdrawal of the timber-covered portion of the catchment area of the streams for forestry purposes is now universally conceded as the proper thing to have been done, it at that time met with a vigorous protest from timbermen, speculators, and timber-boodlers, for that class was here as well as in Oregon and Washington, who used every means and every influence at their command to have the withdrawal set aside. However, the Department of the Interior knew well the full merits of what had been done; the few men who had exerted themselves in getting the withdrawal were insistent on its maintenance, and the Board of Trade of the City of Tulare on January 19, 1892, passed the following resolution, and sent a certified copy to the Department of the Interior.

To the Honorable the Secretary of the Interior:

The Board of Trade of the City of Tulare, California, realizing the necessity o proper preservation of the forests of the country, now being rapidly destroyed, herein desire to express to your Honor our unqualified approval of the withdrawal from sale (pending the inauguration of a more prudent system of disposal and marketing of public timber than has heretofore obtained) of the unsold portion of the forests on the western slopes of the Sierra Nevada Mountains in the counties of Mariposa, Fresno, and Tulare.

The necessity of forest preservation is more than usually important to the counties above named, and among others, for the following reasons:

Our forests prevent the too rapid melting of snows which otherwise must cause destructive freshets, to be succeeded by scarcity of water for irrigation purposes not less destructive of agricultural pursuits than floods.

The system of lumbering heretofore followed has been wasteful of the product, destructive of young timber, and has left denuded areas a prey to fires, or to become a jungle of young growth harmful to the production of milling timber in the years to come.

The public health of the great and fertile valley at the foot of the Sierra Nevadas requires that certain portions of the mountain fastnesses adjacent to the several centers of population shall be set aside and reserved for public resorts; and that such resorts shall not be overrun by bands of sheep or cattle kept for profit of individual owners, which thereby prevents such public and healthful use. Nor will such restrictions necessarily prevent the grazing by sheep and cattle, under proper conditions as to rental, of extensive areas not requisite for public resorts.

We therefore recommend that the timber lands in the counties named be reserved from sale until a plan shall have been matured whereby the denuding of forest areas shall be made to bear the expense, and secure the rehabilitation of such areas with new growth properly thinned out and protected against fire, and that when such plan has been perfected the said reserved lands, or timber growing thereon, be again placed upon the market in such parcels and at such time as a competent forestry commission may deem wise.

In this historic statement I did not mean to digress from the subject assigned to me, but as the streams are of vital importance to the growing of fruit, and as the forest is also of vital importance to the regulation and the maintenance of the stream flow, I deemed a short account of the establishing of a national park and the withdrawal of the Sierra timber lands from public sale would be of interest to a convention of fruit-growers of California, and pertinent to the subject.

RESOLUTION RELATIVE TO THE AGRICULTURAL COLLEGE OF THE UNIVERSITY OF CALIFORNIA.

MR. SPRAGUE. For the sake of getting before the Committee on Resolutions a brief resolution, I would be glad to read it now.

Resolved, That this Convention express its hearty appreciation of the work of the Agricultural College of the University of California as it has been conducted under the direction of Director Hilgard and Acting Director Wickson, and urge upon the Legislature the necessity of liberal appropriations for the work, and especially for the equipment of the University Farm.

To retiring Director Hilgard this State is deeply indebted for the labor of more than a quarter of a century of scientific work, which has, it is believed, given to the State a better knowledge of our soils and their possibilities than is possessed by the people of any other State of the Union. He will enjoy, during his declining years, not only his world-wide reputation as a scientist, but the profound respect and esteem of the people who have had the benefit of the labor of his riper years.

In Acting Director Wickson, as the best informed of all living men in respect to agricultural practice in California, we recognize the man best fitted to take up the work where Professor Hilgard left it, and we recommend to the Regents of the University that Professor Wickson receive the permanent appointment to the position which he now fills, at the earliest date possible, in order that he may with more confidence and authority lay his plans for the rapidly increasing work of the Agricultural College.

MR. JOHN TUOHY. I take pleasure in seconding the resolution.

REPORT OF COMMITTEE ON RESOLUTIONS.

JUDGE AIKEN. Mr. Chairman, the Committee on Resolutions is ready to report.

PRESIDENT COOPER. The last resolution will be placed before the Committee on Resolutions.

MR. JUDD. The resolution I present on the table there is the labor resolution, and it is signed by a majority of the committee, and I move the adoption of the same.

JUDGE AIKEN. The Committee on Resolutions should first make a report, and this will come as the last report. We can take up the other reports first and then finish with the subject of labor.

MR. JUDD. I believe the chairman of the Committee on Resolutions is out of order until that is disposed of. It has the right of way.

JUDGE AIKEN. If that is so, Mr. Chairman, I wish to make a minority report on that subject.

PRESIDENT COOPER. We will hear the minority report after the majority report is read.

SECRETARY ISAAC. I will read the resolution.

Resolution Favoring Modification of the Chinese Exclusion Act.

WHEREAS, Farm labor is becoming increasingly difficult to obtain, and in California especially the great fruit and wine industries are threatened with disaster unless some remedy be found to get more labor; therefore, be it

Resolved, That the fruit-growers of California, in convention assembled, favor such modification of the Chinese Exclusion Act as will permit the enactment of laws making possible restricted immigration of laborers irrespective of nationality.

PRESIDENT COOPER. Now, the minority report.

JUDGE AIKEN. I will read it.

Minority Report from Committee on Resolutions on a Resolution for Virtual Repeal of the Chinese Exclusion Law and the Admission of Chinese Laborers to this Country.

I recommend that the resolution be not adopted for the following reasons:

That the Chinese Exclusion Law is an expression of the will of the nation, regardless of party, and is strongly supported by the President;

That America must remain distinctly American, for the only way American labor can successfully compete with Chinese labor will be to lower the standard of living to the level of Chinese living;

The families that now camp in our orchards and vineyards to earn wages with view of buying homes of their own will be driven from the fields in despair.

Break off the top of the Exclusion Law in order to secure Chinese labor for California and the dark flood of Chinese millions will break over all barriers and flood this fair land of ours.

Is it not better to suffer the ills we have than to flee to those we know not of?

Respectfully submitted.

W. H. AIKEN,
Chairman Committee on Resolutions.

JUDGE AIKEN. Mr. Chairman, this is in the nature of an amendment to the report, and when an amendment is offered to a resolution, the question arises on the amendment, and I would ask the adoption of the minority report.

MR. DORE. Mr. Chairman, it seems that there are two separate reports.

PRESIDENT COOPER. I presume it is unnecessary to discuss these reports, because every many and every woman, probably, has made up his or her mind on this question, and therefore I put the question before the assembly on the minority report—that is, to remove the Exclusion Act. All those in favor, please hold up their right hands.

MR DORE. I don't know that we all understand you. Will you please state it again?

PRESIDENT COOPER. As it is now, we are voting in favor of the majority report.

MR. DORE. Which is for the modification of the Exclusion Act?

PRESIDENT COOPER. Yes, for the modification of the Exclusion Act.

JUDGE AIKEN. To repeal the Exclusion Act. That is all it amounts to.

MR. JUDD. Read the resolution so we will understand it. We don't care to have it falsified.

PRESIDENT COOPER. The Secretary will read it.

(The resolution was again read by the Secretary.)

MR. LEONARD COATES. As one of the members of that committee—the chairman of that committee has made various explanations as to his minority report. I think either Mr. Judd or myself should be allowed to make some explanation of the majority report.

PRESIDENT COOPER. I will allow you five minutes.

MR. JUDD. I want to explain some things that the general public perhaps does not understand. The Government of the United States in the last two or three months has issued a bulletin which I presume some of the members of this Convention have received. The title of that bulletin is "Farm and Farm Values; the Rise and Fall of the Same in California." According to that report of the Government of the United States, it appears that practically all the farm lands in all the New England states, and all the Eastern states, that are in excess of six miles from any populated center, have depreciated in value. One man reports in New York that two miles and a half from where he is now writing his report, eighteen farms have been abandoned. In other places hundreds and hundreds of farms have been abandoned all over the Eastern and Middle and New England states, and in every instance the cause is the scarcity, the poor quality, and the high price of labor.

Now, I want you to take the first volume of the Census Report of the United States, and I want you to look it over carefully, and I want you to dig right down into the bottom facts of the increase and decrease of the population of the State of California in its rural townships. While California as a State increased 22.6 per cent in the ten years, the city populations increased 77.2 per cent. My own home district has decreased in population, and there are but two counties in the State in which there are not one or more rural townships that have not decreased in population. Those counties are Alameda and San Francisco. Santa Cruz County, where I live, has two townships that decreased. Santa Clara County, within five or six miles of San José, has two townships that have decreased in population. You may ask why it is. If you will examine the mortgages, you will find the mortgages eat up the farms, simply because they had not the labor to make a crop on the farms. How many men before me now have got plasters on their places for the sole purpose of paying the laborers that which the profits of the farm will not support? That is all I wish to say.

Now, in support of the resolution, don't let any subterfuge, don't let any sentiment, step in the way. Let us look it squarely in the face. (Applause.)

PRESIDENT COOPER. Your five minutes are up.

JUDGE AIKEN. I will ask three minutes to reply.

PRESIDENT COOPER. You have already made your argument.

JUDGE AIKEN. This man has had five minutes. I want three minutes to reply.

MR. DORE. I want a minute to make a personal explanation after he gets through.

JUDGE AIKEN. A few years since, the residents of Imperial Valley, down in San Diego County, wanted water; and they wanted it bad. They saw flowing the great Colorado River, and they said, "We will go and we will have a restricted supply of water from the Colorado River. We will just dig in the river a little. We will lead it up over our farms. We need it badly, but we will have a restricted supply." And they started to get it, and they got the whole river, and then they sat down in sack-cloth and ashes and said, "For God's sake, we made a mistake. Can anybody remove this great flood from us?" It destroyed their homes, and it destroyed millions of dollars' worth of property—it was destroyed by getting a restricted supply of water.

Now, here are gentlemen who come here and say that that great dam against the Chinese shall be removed to get a restricted supply of Chinese labor. When the hordes of five hundred millions step against that restriction they will destroy that dam and overflow our fair land, and we will be in a worse condition than the men in Imperial Valley. Let us be men, and let us first protect Americans from the Chinese. (Applause.)

MR. DORE. Mr. Chairman, Ladies and Gentlemen: As indicated in my talk last evening, I regret that any acrimonious discussion has taken place, and I regret it now; but I can not and will not on this occasion remain silent when the matter is presented in the manner it is now presented. In walking from this meeting place last night that gentleman said to me, "I am not pleased with the manner in which this committee has acted. I agree emphatically with everything you have said, Mr. Dore." Now, there was an approval; there was an expression, perhaps in confidence, that I ought not to make public here; but I can not and will not remain silent when such matter is presented in the manner it has been to warp the votes of this body on a proposition of this kind.

One thing further: I would like, when the vote is taken, that the men and women who vote stand on their feet and tell us how much of California orchard or vineyard or land they have in charge. Then we can get an intelligent expression of the views of this audience. I don't want to wrangle here. I live in America, a country where majorities rule, and if the majority of the people of this country say that these people should stay out, out they stay; but in the same breath, the Japs and some others that are not as good as the Chinamen, should stay out. Now, Mr. Chairman, I want to know who is voting for it and who is voting against it.

PRESIDENT COOPER. Your minute is up. It is useless to discuss this question. As I said before, every man has made up his mind, so we will put the question now. All those in favor of the majority report please hold up one hand.

There were 43 ayes.

PRESIDENT COOPER. All those in favor of the Chinese Act remaining as it is will hold up one hand.

There were 26 noes.

PRESIDENT COOPER. The majority report has carried. You can present the report of the Committee on Resolutions.

JUDGE AIKEN. Here is a resolution on insecticide control. It is a formal matter asking for legislation. It is approved by the Committee on Resolutions.

PRESIDENT COOPER. Read the resolution.

The Secretary here read the resolution on insecticide control, introduced at the Wednesday morning session, and on motion it was adopted by the Convention.

The Committee on Resolutions reported favorably on the resolution opposing the free distribution of seeds by Congress, and the report was adopted by the Convention.

The resolution favoring a bond issue for the improvement of the harbor of San Francisco was also reported favorably, and adopted.

The resolution offered by A. Sbarboro at the conclusion of his paper on "Wine as a Remedy for the Evil of Intemperance" was reported upon unfavorably, and on motion of the chairman of the Committee on Resolutions that it do not pass, the same was rejected unanimously.

The committee reported favorably on the resolution approving the work of the Agricultural Department of the University, and urging a further recognition of the services of Professor Wickson, which was carried by the Convention, with one dissenting vote, that of Professor Wickson.

PROFESSOR WICKSON. Mr. President, I want to express my profound sense of gratitude to the majority for not paying any attention to my negative vote.

SECRETARY ISAAC. I have here the report of the Committee on the President's Address.

REPORT OF COMMITTEE ON PRESIDENT'S ADDRESS.

The committee to whom was referred President Cooper's address made the following report:

We, your committee appointed to report upon the President's address, beg leave to offer the following recommendations and suggestions:

We recommend the especial attention of the Convention to the paragraph referring to the pear blight, and suggest a resolution giving expression of the appreciation of the horticulturists of California to the United States Department of Agriculture for giving to us the most helpful services of Prof. M. B. Waite and other workers of the Division of Plant Pathology.

We feel that the expression of our President that "the pear blight in one or two localities is very bad," hardly expresses the gravity of the situation.

We recognize the seriousness of the labor problem, and that, as the address truly says, "California can not progress without an increased number of workers"; that proper resolutions should be passed, and committees should be appointed to press those resolutions to the attention of the people of the State, to the end that more laborers may be secured to harvest our crops. At the same time we do not agree with our President that "further planting of fruits shall be discouraged." We feel that Californians should arise to meet the condition which confronts them and not confess defeat without strongest effort to correct the existing shortage of laborers. By all means let the State progress, let capital as well as labor be invited here, and let this body of fruit-growers show to the world our faith in our abilities to care for the fruits which the matchless climate and soil conditions give to us.

Owing to the action of the last Congress of the United States in giving the present Pure Food Law, we suggest the attention of this body be given more particularly to features of the address other than the paragraphs referring to pure food.

The attention of members of the State Legislature should be called to the paragraph regarding an appropriation for a State insectary and a larger appropriation secured for continuing the search for beneficial insects.

Respectfully submitted.

D. T. FOWLER,
C. B. MESSENGER.

MR. A. N. JUDD. I move the adoption of the report.

Motion seconded.

The question was put by the Secretary, and carried.

THE IMPORTANCE OF DRAINAGE IN THE SAN JOAQUIN VALLEY.

By JOHN S. DORE, of Fresno.

Mr. Chairman, Ladies and Gentlemen: The topic assigned to me is one that I, for the past five years particularly, have regarded as the most important problem before the people of the San Joaquin Valley. Those of you who came here at an early day remember the conditions of soil and moisture. You know the depth to water and the need for irrigation, and how rapidly the ditches that took the water out from the rivers soaked the water into the porous land. For more than twenty years Kings River has been turned out upon this plain, and where at the beginning the ground water was very deep in the soil, it is to-day, and has been for a long time, near the surface, and in many places on the surface. Scattered over this valley are places where once grew orchards and vineyards that were productive, adding to the wealth of California and making beautiful and prosperous homes. By the rise of the ground water, bringing with it the salts and alkali to the surface, some of those homes have been destroyed, and large areas of land have been rendered unproductive.

In 1902, through the advice and with the assistance and encouragement of Professor Hilgard, I began in a humble way to try to interest the National Government in a problem which was too large for me, and too large for the community in which I resided, to grapple with. We adopted some resolutions in the grange in our community. Next the Chamber of Commerce in Fresno did the same; and after that the raisin-growers did the same. We asked that the department of the experimental division at Washington should send a competent man here to investigate the conditions and outline a remedy. Considerable correspondence was exchanged. Secretary of Agriculture Wilson sent out Dr. True, who stands at the head of all of the Experiment Stations of the nation. He came to Fresno and looked over the field, and reported to the Secretary of Agriculture what he found as to the conditions. It was my pleasure to ride over the country with him and to stand by his side. After he had pretty thoroughly examined the conditions, he penned to the Secretary of Agriculture a telegram saying, "The investigations asked for at Fresno are imperatively demanded by the conditions I find." Secretary Wilson then ordered that an examination should be made by the best engineering force at the command of the Department. The engineers came out. Some 20,000 acres were carefully examined and a plan of drainage was outlined. Wells were bored to determine the depth of water, and reports were printed as to the conditions and distributed among the people, but a large majority of the people do not comprehend the situation.

These Government men who were sent out here outlined two methods by which we might reclaim this land. One of those plans was by pumping into the irrigation ditches and running the water off, and the other was by gravity system and open drains. Either plan would cost about the same to install—some $14 an acre for the main drains. Additions to this would have to be made to drain the individual land. After the Government had spent some $12,000, and had done a very great deal of intelligent work, we decided to organize a district and proceed to drain the country and reclaim it. There was no law in California by which we could vote bonds, so the next move was to get such a law, and then our next recourse was to the President of the State University, and through his influence we were enabled to get a good law.

Now we are going to pump the ground water down. We are going to have the machinery to do it, and in a few weeks we will be able to pump this water out and irrigate other land.

(At this time a recess was taken until 7:30 P. M.)

EVENING SESSION—THIRD DAY.

THURSDAY, December 6, 1906.

The meeting was called to order at 7:30 P. M. President Cooper in the chair.

PRESIDENT COOPER. We have received a letter from Mr. J. A. Filcher, saying that he can not be present on account of sickness in his family. There were two papers that were laid aside this morning on account of lack of time. We will take up those papers before we commence on this evening's program.

GOOD ROADS, AND HOW TO GET THEM.

BY A. R. SPRAGUE, OF SACRAMENTO.

The principles of road-making are few. Some one has well said it may be summed up in, "Keep the water out of, off from, away from the road." This involves proper drainage to make sure that the soil is not saturated within from four to six feet of the road surface. It makes necessary the packing of the road material, and particularly the surface, in order that, from travel, no depressions may result that prevent water from draining off.

Where possible, it suggests the use of heavy asphaltic oil to the smooth, hard surface, in order that it may be perfectly water-proofed. The asphalt of crude oil, like paint, is adhesive, but not cohesive, and should be used precisely as if it were *a paint*—to be applied only upon a hard, smooth surface, and only so much of it as will sink into the material of the road surface, *and never in any other way.* Only one exception to this rule is known: where it is to be used only to prevent dust and not to water-proof the road. In this case but little should be used, much short of saturation of the dirt. Thus used, it will not seriously increase the draught of vehicles and will prevent most of the dust from rising.

In case of applying oil to a sand road, it must penetrate deeply enough to give a heavy body of resistance to pressure, and the sides of the track should be so protected as to prevent the breaking down of the edges.

All oil should be used as nearly cold as it can be handled conveniently, as the lighter oils which are driven off by heat are the chief solvents of the asphalt, which enable it to penetrate almost any hard surface.

Where clay can be added to sand, or sand to clay, and well mixed and puddled and kept smooth by road drag, or other such expedient, a very good surface for light travel results. Where it can be given two inches of broken rock and traveled and sprinkled until the surface is well bound together and hard, and then is given a light coat of heavy asphalt crude oil, a very desirable, dustless road, at small cost, will result. No road should be rounded more than three fourths of an inch to the foot—just enough to carry off the water.

As applied to a wide area varying in industrial development and natural conditions, "good roads" may be defined as roads constructed upon a scale of cost proportioned to the amount of travel upon each per mile, so that within reasonable limits of expense every portion of the commonwealth shall have easy access to its centers of business and to railway and water transportation. The cross roads and branch roads, having comparatively little travel, may well be constructed and maintained with comparatively light cost, while the main lines of travel must be built to resist much hard usage and to require little expense for annual maintenance. This at once suggests a classification of the highways of the State upon the basis of the prevailing use of the same.

This is the principle governing in railway construction—the roadbed and rails must be fitted to the traffic which is to go over them: a four-track, rock-ballasted roadbed, with straightest practicable lines and lowest gradients—constructed nearly regardless of cost for main lines with heavy traffic; while remote branch lines with but little traffic may be left with single-track light rails, roadbed unballasted, and with curves and gradients consistent with low cost construction. Doubtless every railway manager would be delighted to have every mile of branch track as well constructed as his main lines, but to attempt this would be to court bankruptcy.

So in this State of California, doubtless every citizen would be glad to have every mile of our fifty thousand miles of public highway made of the best macadam; but this could only be achieved by most excessive cost. Yet the macadam construction of main lines, with properly graded, drained, and compacted branch and cross lines, is an entirely reasonable ambition for the people of California to entertain. No people able to have good roads can possibly afford to have poor ones.

The U. S. Department of Agriculture has been making very careful investigations as to the average cost of tonnage haul upon the highways of the United States, and reports that it is slightly over 25 cents per ton per mile, while upon good macadam roads the cost is not in excess of 10 cents per ton per mile. (See Report U. S. Dept. of Agr., 1905.)

From 1884 to 1904 the people of California have spent $49,567,000 upon their roads—nearly two and a half millions per year—and our roads are still very poor. But this waste of money is the smallest part of the loss to the people of our State from the failure to enter upon permanent highway construction. The Secretary of Agriculture estimates at $500,000,000 the annual loss of the people of the United States from the greater cost of traffic upon poor roads than upon good ones. California's share of this would make a large addition to the two and one half million dollars, most of which we have yearly thrown into the mud.

Apart from this heavy money loss from bad roads, consider the social isolation which they compel. At best, in the larger part of California our rural population is widely separated. How much nearer together good roads would bring them, thus adding greatly to the attractiveness of country life and giving greater efficiency to church and school.

If many of our communities were to be barred from travel to and from their nearest town by toll gates, where they were assessed from 5 to 15 cents per mile for every mile traveled with a moderate load, what a protest would arise and how soon those barriers would be abolished; and yet their bad roads constitute a barrier just as expensive as the toll gates would be, and they protest but feebly.

California is the natural playground of the whole East. With good roads the prevailing condition in California, the millions would be trebled which Eastern people now spend during their yearly play spells here, and many more of them would determine to spend all of the year amid the delightful surroundings of fruitful orchards and sea, rivers, and mountains, with roadways of such excellence linking all as to permit, with modern vehicles, a freedom and ease of travel only equaled by the flight of birds. Surely California, of all states, can not afford poor roads.

Our present road law was evidently enacted upon the supposition that only the farming population should be taxed to maintain public highways, it being considered that as the cities take care of their highways they should be relieved of any care of roads beyond their city limits. This is now very generally held to be a mistaken view of the matter. If it costs four times as much to haul supplies for the city over bad roads as over good ones, does not the city suffer because of such roads? Even if the supplies go from farm to railroad and thence to the city, the loss is still evident. To get their goods to the country consumer, the city merchants need good roads as much as does the farmer to get his to the city. Cheap transportation to and from a city probably is the chief cause of rapid city growth.

The effect of the embargo placed upon traffic by bad roads is the same as if some foreign power were to be permitted to place toll gates, with extravagant charges, upon every public road and then appropriate to its own use all of the revenues therefrom.

In such cases the city surely would not be indifferent. The less it costs the farmer for the transportation of his products and supplies the more he will have to spend in the city. Again, it is altogether unfair for the citizens of the commonwealth who happen to be placed where the population is from ten thousand to fifty thousand to the square mile, to insist that where the people number but ten to the square mile they shall maintain their own roads. To do this effectively would require that they be taxed for public uses many times as much as the city inhabitant.

The centers of population everywhere are the nurseries of crime and incompetency, which load vast expense upon the State. These expenses are shared by the rural population and without protest, although they are thus taxed quite out of proportion to the expense caused by their own criminals and incompetents.

From every point of view it seems just as desirable that a large part of the cost of the construction and maintenance of public highways should be provided by State funds.

The advocates of national aid in the construction of main lines of road connecting the various parts of the whole nation, it seems to me, have much force in their arguments. The right of the nation to appropriate funds for such a purpose was fully considered at the time the old Cumberland and St. Louis turnpike was begun in 1807. Even the sticklers for State rights, such as John C. Calhoun and Hayne of South Carolina, were earnest advocates of this national highway. The arguments afterwards used to justify the vast subsidies given by the United States to great railroads were used with far greater propriety in support of this Cumberland turnpike, since it was to be free to all citizens who might desire to make use of it. It was urged that it was necessary to provide for the easy transmission of the mails, an argument good to-day, for the distribution of the mails still involves the use of the public highway in very great measure, so that the annual expenses of the postoffice are vastly larger than they would be if the contract route carriers could make use of good roads. The excessively high rate of 8 cents per pound, payment to the railroads for carrying the mails, aggregates a vast sum in excess of reasonable and customary charges, which excess would far better be spent upon the public highways of the nation, facilitating the delivery of mail upon thousands of miles of post roads.

Since the National Government reserves to itself the power of indirect taxation, it is proper that the funds thus raised, after providing for the necessary functions of the Government, should be used for the benefit of the whole people, so far as this is possible, and in no way is this more possible than in the construction of permanent highways.

The nation is not averse to taxing the farming population in order that urban manufacturers shall flourish, nor does it hesitate to appropriate vast sums for the improvement of rivers and harbors which advantage most those adjacent to them.

It may be considered that such use of national funds is wise; but if so, how eminently just that the great interior farming populations should have some national assistance in providing easier transportation for the vast product of their toil.

Secretary Wilson, of the U. S. Department of Agriculture, recently stated that the farming class, which is but thirty-five per cent of our whole population, has in ten years produced an amount equal to the entire national wealth—the production of three centuries. Surely these producers are entitled to the utmost possible consideration, purely from an economic standpoint even. No other assistance could exceed the value of helping them to secure good roads.

In very many parts of the country it is felt that the freight rates are excessive, and possibly they are, and yet as a result of better railroads—lesser grades and curves, and heavier rails with well-ballasted roadbed—freight rates have been greatly lowered in the last twenty years, until, with the present cost of labor and supplies, managers of railroads claim that rates can not be further reduced.

However, the average haul to the railroad costs more than the average railroad haul to market, and clearly this cost may be decreased by two thirds, by providing good roads. This, therefore, would have the same effect upon the prosperity of the country as would a heavy reduction in the freight rate, since the cost of getting things to market from producer to consumer, both manufactured articles and the products of the soil, is usually made up of wagon haul and railroad or water transportation; and so if either part of this total cost is lessened the burden laid upon the producer is lessened in that proportion.

I have doubtless said enough about the *value of good roads*, for no one refuses to concede this. However, I have been desirous of giving the greatest possible emphasis to the fact that *bad roads are wasteful*. What, then, shall we do?

This State, every State, is abundantly able to have them if we will but set out to get them in some orderly and efficient fashion.

In the first place the people must be stirred to feel the necessity of action to secure some effective legislation for this purpose. Fortunately we need not enact any legislation experimentally, for other states have already enacted laws which, after several years' experience, are proving entirely satisfactory. A provision for State aid for a large part of the cost, with the balance divided between the county and the local district, characterizes nearly all of these recent laws.

New York in 1898 initiated her extensive road improvement work by passing the Higbee-Armstrong Act. This provided for a constitutional amendment, twice approved, authorizing $50,000,000 in fifty-year bonds for permanent road construction. Under this Act $10,746,707 has been spent from 1898 to 1905. The Fuller-Plank Act, 1899 to 1905, provided for bounties to counties and townships adopting the contract system in place of the custom of the farmers of working out their tax by personal service upon their own local highway; under this law $5,540,000 has been spent between the years 1899 and 1905.

Under the Higbee-Armstrong Act the State pays half, the county thirty-five per cent, and the township fifteen per cent of cost; all plans for work must be approved by the State road engineer, and no work is accepted until after approval by the County and State road engineers. The work in any district must be initiated by petition from the locality desiring the improvement. The popularity of this law may be judged by the fact that, up to 1905, 5,466 miles of road construction have thus been petitioned for. (See N. Y. Report, 1905.) Under the Higbee-Armstrong Act $5,000,000 is available as State aid every ten years.

An admirable synopsis of recent road legislation by the several states is contained in the Year Book of the U. S. Department of Agriculture for 1905.

All of the New England states, and New York, New Jersey, Delaware, Pennsylvania, Ohio, Illinois, Wisconsin, and Minnesota have enacted laws proposing to secure permanently good roads in an organic, progressive manner.

The U. S. Department of Agriculture, among its many beneficent activities, is conducting a department of highways which is inquiring, experimenting, and promoting, in the interest of good roads for the whole United States. May we not reasonably hope that this is the beginning of national aid, which shall enlarge its effectiveness as rapidly as the states shall prepare themselves to make use of it efficiently?

Efficient organization should precede extensive appropriations. Fortunately the recent road legislation of many states is very strongly of a common type, which, if followed by the rest of the states, will make national aid easily effective whenever it may be provided.

What place is California taking in this great movement for good roads? We are distinctly in the rear. Not in the very last rank, it is true, for with the "work tax" method from which many of the states are still struggling to free themselves, we are not incumbered. We have also a State Highway Commission, whose functions are purely advisory, except as special construction of lines of State highway are authorized by the Legislature, and funds provided. Beyond this our road construction, outside of incorporated towns, is in a condition of simple anarchy. The County Supervisors undertake to supervise road construction and maintenance in their several supervisoral districts, and their custom is that of the ancient Hebrew days, when, it is recorded, "each man did what was right in his own eyes."

Many County Supervisors are very capable men, but few, if any, are competent road engineers. While much excellent work has been done by individual Supervisors, even this work is largely wasted, because not followed up in some harmonious fashion by their successors in office. In far the larger number of instances, however, the work is simply left to local ranchers, who follow their own notions in road repair, using their own teams, or bestowing patronage upon their neighbors, as the situation may suggest. Under these laws, in the last twenty years, we have, on the average, annually thrown into the mud nearly two and a half million dollars (see Report of U. S. Department of Agriculture, 1905), and we still travel most wretched roads, characterized by mud in winter, and dust and holes and hummocks during the dry season; in many places without proper drainage, and with poor road grades in the rougher areas of the State.

What are the influences tending to maintain these deplorably bad road statutes?

First among these we place inertia, resistance to change, an indisposition to take any trouble in a matter requiring so much thought and energy for its development and application.

Second—It is commonly supposed that the County Supervisors will strenuously resist any legislation tending to limit their patronage and so to weaken their political support.

Third—The increase of taxation which it is supposed must result from entering upon the extensive construction of permanent roads.

Fourth—The supposed unwillingness of the cities to be taxed for State aid in such highway construction.

Fifth—The presumed indifference of the people in certain areas of the State where the roads are already fairly good, either because of natural advantages, or by reason of more generous expenditure and more wise activity in road construction and maintenance.

These are doubtless the chief difficulties to be encountered in securing adequate legislation for good roads.

The first difficulty, the inertia of the people, can only be overcome, as in mechanics inertia is overcome, by energy. We may not sit down and wait for good roads to grow. They won't do it. Only intelligent and persistent agitation in the interest of good roads will secure them. The subject should be considered always in order everywhere, at all local and general associations and conventions. We should see that an adequate road construction exhibit is provided for the annual State and County fairs. Good roads associations should be formed, wherever practicable, for discussion and demonstration. We should secure the presence in our State of the Good Roads demonstration train, such as has been demonstrating in other parts of the United States. The hearty coöperation of our great continental railroad companies can no doubt be secured, as east of the Rocky Mountains the great railroad companies have given most generous and hearty support to this movement. Every Farmers' Institute should include this topic in its program, and our colleges and great universities should actively support the movement both by discussion and courses of instruction in road engineering.

In case it should prove impossible to secure proper legislation during the next session, it would be desirable to enable the Commissioner of State Highways to carry on an active campaign in the interest of good roads, making him responsible for organizing all the forces available for such a purpose.

The second difficulty, the opposition of the Supervisors, is not likely to prove at all serious. Our County Supervisors are paid but beggarly salaries for the work required of them. Where a friend and political supporter is gained by an appointment as road overseer, a half-dozen enemies are made in those who hoped to get it and failed. The Supervisor's task is generally a laborious and thankless one, and doubtless the majority of them would be glad to be relieved of the burden of road supervision. Many of them are representative citizens who could be counted upon to take the lead in a movement so manifestly for the advantage of the whole people.

The increase of taxation is not an argument that will bear investigation. A road is like a cow. A cow is cheap almost regardless of her first cost, in proportion as her annual product exceeds her cost of maintenance. So a road is cheap only in the proportion which its efficiency through a term of years bears to its cost of annual maintenance. The millions of money which we are now spending to procure a poor and temporary efficiency would go far in the making of permanent roads. Again, good macadam roads properly cared for at trifling annual expense will last for half a century. Why not, then, let the next half century assist in paying for them by the issue of long-term State bonds? This is true economy, for the reason that the use of money can be obtained by the State at much lower cost than by any subordinate part of the State, and for the further reason that construction wisely planned on a large scale is much more economic. Interest and sinking fund sufficient to pay a bond issue of $50,000,000 can be provided with no more money than California yearly spends in temporary construction.

Again, as in other states, prison labor is used, greatly to the advantage of prisoners and roads. Such labor in this State might well be used to a large extent to decrease the cost of permanent road, culvert, and bridge construction, and in the construction of road machinery.

It is stated by careful investigators that the rise in property values in cities, consequent upon paving and sewerage, often many times exceeds the cost of such work. Without question the rise in values of property adjacent to good roads would go far to afford a fund for their construction without seriously increasing the rate of taxation.

The remaining argument is, that important areas of the State have already fairly good roads and, therefore, they would probably protest against assisting in any general scheme for road improvement. This protest probably will not be raised, for in other states it has been found that those communities which already enjoy many fine roads are the most active in promoting a like improvement for the whole State.

An amusing illustration of the kind of communities which most oppose the movement for good roads occurred in the New York campaign. When the constitutional amendment was pending providing for a $50,000,000 bond issue, the strongest protest came from an interior community which wished the consideration of the matter by the legislative committee postponed, giving as a reason that the mud was so deep that they could not reach the meeting point.

The outlook for suitable legislation in California seems most encouraging.

The limit of this paper does not permit even a synopsis of recent road legislation in other states. This will be found in the Year Book of the U. S. Department of Agriculture for 1905, before referred to.

Either the New York or the New Jersey law, with modifications to adapt it to California, would afford an excellent method of procedure. Each divides the cost among the State, county, and local communities; each provides for systematic and progressive construction, with expert and responsible supervision, which is non-partisan to the largest possible extent. We should not ask for less in California. We shall secure good roads at far less cost in California than in the Eastern states, because in most parts the roads are free from the disintegrating effect of annual frost; and since the road metal or macadam structure is not for the purpose of bearing weight, but only to resist wear, with the proper consolidation of the dirt substructure, this macadam or gravel surface may be made much thinner than in Eastern states and yet give equally good service.

Again, no part of the State is very far from rock available for crushing for road metal, and, perhaps most important of all, we have very cheap crude oil, rich in asphalt, which, properly applied to the hard, smooth surface of well-packed macadam or gravel surface, renders it hard, smooth, water-proof, non-abrading, and so practically indestructible.

In this connection I venture to relate some significant experiments in Sacramento recently. The use of oil upon roads had become most unpopular in Sacramento and vicinity, for the reason that it had been so applied, both upon macadam and dirt roads, that in summer hardly more than half a load could be hauled over their yielding surfaces, and with the advent of the rainy seasons these surfaces worked up into a most vile mud, which took off the hair from the legs of the horses, the paint from the buggies, and provoked most profane utterances from divers and sundry drivers.

Hence the attitude of the City Board of Trustees, of whom I asked the privilege of demonstrating that oil could be used upon macadam so as to produce a perfect road surface. They authorized the experiment upon two blocks, but declared that if it failed they would use oil no more upon their streets.

Two blocks were selected upon H street, between Thirteenth and Fifteenth. The pavement had been down over two years and had been subjected to extremely hard travel, so that in very many places depressions had been worn of from one half to three fourths of an inch in depth and in area from half a square yard to two yards square. The street was washed clean by a torrential rain a few days previous to the application of the oil, and any dust which had accumulated in the meantime was swept off, leaving the surface clean, well cemented together and hard. Then heavy crude oil of about 12° gravity, heated only sufficiently to permit it to be handled, was applied so as to thinly but entirely cover the surface, and travel was kept from the street for about two weeks. Then a very fine gravel was thinly sprinkled over any surface remaining at all sticky, and the street was opened to travel. The demonstration was made in March, and three days after the oil was applied a heavy rain fell, which did no harm except to separate the oil in the puddles from contact with the surface of the road beneath, thus preventing its proper penetration into such surfaces. Several rains followed after the street was opened to travel, and except where an undue amount of oil had been used—more than would penetrate the surface—the road remained in fine condition.

So satisfactory was it that the City Trustees ordered that all macadam surfaces in future should be treated in this fashion, and L and Twelfth streets now show surfaces which are often mistaken for asphalt, but which in some ways are better than asphalt and which cost but a fraction as much.

In later experiments we demonstrated that such depressions as are above referred to can be filled and their surfaces be made to shed water, by throwing in macadam or gravel screened to about the diameter of the depth of the depression. Also, that a subsequent application of oil perfectly unites with the road surface.

Where a street is thus treated it is practically everlasting, with but a trifling use of oil in repair. It is free from dust arising from the abrasion of its own surface, and hence may be kept very clean by sweeping. In wet weather it is not so slippery as is asphalt, and yet heavy loads can be hauled over it without difficulty, as it presents an almost perfectly unyielding surface. On country roads the rains and winds would keep the surface clean. In mountain sections and elsewhere where it is not possible to keep travel off the road a sufficient length of time to permit the oil to penetrate the surface, it is probable that a thin covering of carefully screened, broken rock, excluding all the dust and finer and hence more absorbent material, would enable the oil to penetrate the hard roadbed and finally consolidate with the rock covering. No road which is thus oiled will be injured by torrential rains. I am sure I speak moderately when I say that the right use of crude oil upon our roads will enable the people of California to build and maintain good roads for long periods of time at less than fifty per cent of the cost of construction and maintenance without it.

I close this paper by quoting from an address by the father of modern permanent road construction in *1786* (?), at the beginning of a movement which in bleak and rocky Scotland secured the construction of one thousand miles of permanent roads in the first decade of the last century:

"Surely we have satisfied ourselves now by wasting all our time, by squandering our money, by wallowing in the mud with our teams in the transmission of our commerce. Let us for once lay aside all our foolish ideas and treat this question as a business proposition; a proposition of importance. Let us assemble in public conferences; let us give to these conferences the benefit of all our experiences. Let us not leave these rooms until we have resolved ourselves into a convention that will adopt and lay down some plan, some system, some regular business method that will provide for the proper construction of our roads by annual installments. Each year seeing an improvement upon the last; each year seeing a certain amount of roads built and these extended from year to year until we radiate from the centers, that is, the towns, and eventually reach the limits of our possessions."

MR. SPRAGUE. Now, Mr. Chairman, to make this paper effective, I beg to offer the following resolution:

WHEREAS, It is everywhere conceded that the present laws and prevailing customs of road construction and repair are most unsatisfactory and wasteful, resulting in an enormous waste of public road funds and a greater waste of private funds resulting from bad roads; and

WHEREAS, The experiences of many other states already demonstrate the advantage of coöperation of State, county, and local communities in the construction and maintenance of good roads; therefore,

Resolved, That this Horticultural Convention urgently requests the State Legislature to submit, for the approval of the people of California, a constitutional amendment providing for the issuance of State bonds sufficient in amount to provide fifty per cent of the funds necessary to construct progressively a system of good roads throughout the State, and to enact such legislation as will secure such construction under the plans and supervision of the State Highway Commissioner, and also provide for the proper coöperation of the county and the local communities in which such construction is undertaken, directing that each of such communities shall provide for paying for an equitable proportion of the cost of such roads, and shall in all such construction and repair of roads be strictly subordinate to the State Road Engineering Department; in general, following the lines of road legislation which for several years has been found so satisfactory in New York and other Eastern states; and be it further

Resolved, That to carry out the spirit of this resolution a committee of three be appointed to coöperate with similar committees from other organizations to properly get the matter before the next session of the State Legislature.

A MEMBER. I move the rules be suspended and the resolution be adopted.

Motion seconded.

PRESIDENT COOPER. The question is on the suspension of the rules. All in favor say "aye."

Carried.

PRESIDENT COOPER. Now, the question is on the resolution. All in favor of the resolution you have just heard read, say "aye."

Carried.

PRESIDENT COOPER. The next paper is "The Relation of Bees to the Fruit Industry," by J. M. Rankin.

THE RELATION OF BEES TO THE FRUIT INDUSTRY.

BY J. M. RANKIN, OF CHICO.

I do not want my hearers to imagine for one moment that I am going to attempt to cover the entire field as my subject would indicate. On the contrary, I want to consider briefly a few of the ways in which the bee may be useful or otherwise to the interests of the fruit-grower.

Unfortunately there is in some of the fruit sections of this State a prejudice against the bee. This makes it necessary for us to discuss two different phases of the question: First, the good resulting from the presence of the bees; and second, the possible damage done by them.

It is an undisputed fact that the blossoms of most of our fruits are self-sterile. They require some outside agent to complete their fertilization. In some instances all the fertilizing agent necessary is the wind; but this is true, I think, to a very limited extent with our fruits, owing to the adhesive nature of their pollen. They require an assistant or servant, as it were, to do this fertilizing for them, and almost universally this agent is found in the insect world.

In nature all life is so proportioned that each individual fills its natural place; but when man enters with his aggression and progress, conditions are changed. He sows hundreds of acres of wheat, and the Hessian-fly breeds and multiplies faster than its natural enemies, and so damages the crop. He plants thousands of acres of fruit, and the pests on this fruit, imported with it from other countries, and in the absence of their natural enemies, thrive and multiply. They become such a pest that the fruit-growers must fight them, and yet in nature there was provided a remedy to hold them in check. So, then, with the multiplying acres of fruit some artificial means of assisting in its fertilization becomes necessary, and the most efficient and easily installed agent is the honey-bee.

If we were certain of clear weather during the entire time the trees were in bloom we would not worry, but unfortunately it often happens that one variety of fruit will only see a few hours of fair weather while in bloom. This was true the past spring in regard to a peach orchard standing beside the Plant Introduction Garden at Chico and under the writer's observation. The time of bloom happened during a prolonged cold storm, and the blossoms saw less than a half day of sunshine. The insects on this bloom numbered four bees to one of another kind, not because there were more bees than other insects, but because the bee is the strongest insect that does this work and will fly during inclement weather when other insects are unable to do so.

The progressive fruit-grower of to-day is the man who does not leave a straw unturned to secure the best possible yield in his orchard. He is beginning to realize that in the past he has neglected to assist nature in this respect, and so lost crops that might have been profitable.

The blossoms were placed on the trees for a reason, and the nectar was placed in these blossoms for no other reason than to attract the insects, because the tree wanted their assistance to enable it to produce its fruit.

In regard to the second part of my subject, I think the most of my hearers will agree that the drying yards where fruit is being cut is the only place where bees sometimes become a nuisance. If a dearth in the honey flow comes at the time when the fruits are being placed on the trays, bees sometimes cause more or less annoyance. I regret that more beekeepers have not guarded against this honey dearth, which occurs almost universally over the State in July and August. Some such plant as *Melilotus alba* or *Phocelia taucetifolia* could be scattered in waste places, and these would occupy the attention of the bees when nothing else was in sight.

In regard to bees puncturing and eating the fruit, let me say plainly that it is absolutely impossible. The mandibles of the bees are constructed in such a way that they can not puncture the skins of fruits. Place a bunch of ripe grapes inside a beehive and the bees will coat it over with propolis, and if the grapes have all been perfect ones none of them will be punctured. Prick the skin of one half of another bunch and place this bunch in another hive, and the bees will clean out the punctured grapes and coat the rest with propolis. Let a mouse or a lizard get into a hive and the bees will embalm him with this same propolis. Hang a string between the frames of a hive, and it will be unraveled and carried out bit by bit. A piece of cloth will suffer the same fate, showing that the bees tolerate the bunch of grapes for the same reason they do the lizard and the mouse; that is, because they are unable to remove them.

Many orchardists to-day have established small apiaries on their premises, because they realize that the presence of the bees sometimes means a fair or even a good crop of some certain fruit, when their absence would have meant an entire failure. This is particularly true of the almonds and earlier blooming fruits that are apt to select for their period of bloom a run of cold or rainy weather.

Let me quote a portion of a personal letter from the President of the Yolo Orchard Company. He says: "By close observation we were led to believe that the working of bees in our almond orchard, especially during seasons when little dry weather prevailed, materially added to the fertilization of the bloom by the mixing of the pollen. We were sufficiently convinced of this fact to feel justified in the purchase of fifty colonies of bees, and still retain them, although they have not made enough honey to justify taking any from them. On the other hand, there is no question but that bees, as well as all insects and birds, carry the germs of pear blight, which has become a very serious menace to pears, apples, and quinces."

As a rule, the fruit sections are not the honey-producing sections, and so it is not probable that any fruit section will ever become heavily stocked with bees. In fact, it is generally conceded that, aside from the orange, there is no fruit bloom that produces enough nectar to justify maintaining the bees for the honey they produce, but many prominent fruit-growers are doing just what the Yolo Orchard Company has done; that is, installing a few colonies of bees for the sake of occasionally insuring a crop that would otherwise be a complete failure when the blossoming period happens to fall at a time when, owing to weather conditions, other means of fertilization are unable to accomplish the work.

PRESIDENT COOPER. The next is "A Fixed Price for Prunes, and How to Obtain It," by J. Luther Bowers.

A FIXED PRICE FOR PRUNES, AND HOW TO OBTAIN IT.

By J. LUTHER BOWERS, of Santa Clara.

Prunes are now so well known that every school boy and girl, from the rock-bound coast of Maine to the perpetual summer region of California, and from Puget Sound to Florida, has for a by-word, "You are full of prunes." So it will not be my object to advocate that we advertise prunes, but I will show you that too much advertising has been done already, and that the essential feature, the keeping qualities, has been left out, or overlooked. And I wish to show the prune-growers that good prunes can be grown in Kings County. Almost every section of the State of California has made itself famous for some production. Salinas for potatoes, Watsonville for strawberries, Pajaro Valley for apples, Petaluma for eggs, Lodi for Tokay grapes, Merced for sweet potatoes, Oroville for early oranges, Santa Barbara for walnuts, Santa Clara Valley for prunes. Why not make Hanford famous for her large prunes of fine quality?

Sonoma and San Joaquin valleys have been advertising Santa Clara Valley prunes for the last fifteen years. My hearers will say, "In what way?" All over the United States and elsewhere, market quotations read: "Santa Clara prunes, 'so and so'; Sonomas one eighth and San Joaquins one fourth less." This is a plain acknowledgment that Santa Clara prunes are the best, consequently Sonoma Valley and San Joaquin Valley have a standing advertisement booming Santa Clara Valley prunes, and the loss to these two valleys each year is great.

The Santa Clara County packers buy many carloads of Sonoma and San Joaquin Valley prunes from one eighth to one fourth cent per pound less than they have to pay for Santa Clara prunes, and brand them "Santa Clara Prunes." It is also a well-known fact that packers outside of Santa Clara Valley brand their prunes "Santa Clara Prunes."

Let the Kings County grower stop this business. Pack your own prunes and brand them "Hanford Prunes, grown and packed in Kings County, California."

What are the conditions to be met with in the East? Do our prunes keep when processed and packed in cartons and twenty-five and fifty-pound boxes now in use?

During the past summer I made an extensive trip all over the Middle West and the East, visiting all the large cities from New Orleans to Boston and from Boston to Chicago and Kansas City, and on this trip I found in many localities prunes that were certainly not fit for food I will name a few localities that certainly were a poor advertisement for California prunes.

At Lexington, Va., July 6th, I visited three stores and was told, "We do not keep prunes in stock during the summer months, for the reason that they get wormy and full of little bugs."

In Washington, D. C., July 11th, I visited the celebrated Center Market. There I found prunes in very bad shape. A lot of 80–90's were so sugar-coated that they had lost all resemblance to prunes. Price, 5 cents per pound. Certainly no California prune-grower would want to eat such prunes. A box of 40–50's was shown—some four or five pounds had been sold out of the box. My wife asked the price, and was told 20 cents per pound. She picked up two or three prunes to see how they looked, and in so doing exposed a lot of mold; all of the bottom of the box was one mass of mold; certainly one half of the box was not fit for food.

Four days later at Martinsburg, W. Va., I visited four grocery stores, but found no prunes for sale. All said, "We can not keep prunes during the hot weather." And two said, "Did you ever examine your prunes with a magnifying glass?" I was told here that "all California prunes were full of little bugs."

July 26th I was in Lawrence, Kan., and here I visited three large grocery stores and found the same conditions that I found in the East. "They kept no prunes during the summer months."

Professor Childs, who had charge of the prune demonstration from Santa Clara County at the St. Louis exposition, in his report said, "By the 10th of August there was not a box that we dared to open. All the processed prunes had spoiled."

I do not think I can better illustrate the conditions East than by quoting from Mertz's Magazine for November:

"*True Story about Prunes.*—Who can say, in the face of the evidence, that the conventions of the Pacific Coast Advertising Men's Association have not been a factor in creating the present satisfactory condition of the prune market? In a single paragraph the editor of the 'Graphic Los Angeles' goes on record as having bought five separate lots of prunes as the result of the prune talk at the Los Angeles convention. If we may be allowed to give a bit of fraternal advice, let us suggest, Editor Chapman, change grocers. No respectable grocer knowingly sells 'little bugs' with his prunes. So here's hoping that he will try again. Here is his lament:

"'Prunes! California prunes! Of thee I sing.' I attended a meeting of advertising agents some time back, when one of the speakers gave an address on California prunes as a breakfast food. He held that California prunes should take the place of the cereals that we foolishly consume for breakfast. I agreed with him, and began to buy prunes, California prunes. The first lot was all right; the second was worm-eaten; the third was good; the fourth was suspiciously stale; the fifth was full of little bugs, and I quit."

California prunes would be all right if they were prepared with the same care that is given by Eastern manufacturers to their food production. But this does not seem to be the case. You can buy any of the accepted Eastern cereals for a year, and every package will be just as good as the preceding one. Our prunes vary from perfection to impossibility. Do we need a prune trust that will turn out packages of even excellence and reliability? When that happens, perhaps we will all be full of them.

Now with such as I have stated, is it any wonder that our prune industry has been in such a demoralized condition for the last five years? Were it not for cold storage, the present mode of packing would soon go out of commission. As long as cold weather lasts in the East, a box of processed prunes will keep; but just as soon as the Eastern temperature gets up to 70° and over, processed prunes will spoil, unless sold very soon after being taken out of cold storage. They either sugar-coat, mold, or get full of little bugs.

I have known for many years that a processed prune would not keep in the Eastern summer heat. Yet I never had an idea that conditions were so bad until I investigated for myself.

During the last six years I have made many experiments to find some way to overcome the loss from sugar-coat, mold, insects, and shrinkage. Some two years ago I was lucky enough to discover a way to overcome all of these difficulties. Since that time I have made many tests as to keeping qualities, and in every case the prunes showed up perfect.

The next thing was to find a market for the goods. On July 26th I started East, but before going I sent by express a large lot of samples, packed in one-pound glass jars, to Richmond, Va., Baltimore, Md., Indianapolis, Ind., New York, Chicago, and Vancouver, B. C., and took with me a case holding ten jars. My case was replenished at points where I had sent samples ahead. Wherever my goods were shown they were pronounced of the finest quality ever seen.

In Philadelphia a jar of the French imported prunes was opened and compared with mine, and all who tasted them said my goods were of a better quality than the French goods. My goods were to be retailed at 20 cents per pound and the French goods at 45 cents per pound. Certainly no fear of competition with such odds in my favor. My goods will be packed in tin cans holding, net, 1¼ pounds, 2½ pounds, and 5 pounds, and I only make three sizes: No. 1, 30–50's; No. 2, 50–70's; and No. 3, 70–90's. I have with me several cans of No. 1 and No. 2, and you can see by the label that the price to the consumer is printed on the label. Prices of No. 1 are as follows: 1¼-pound cans, 25 cents; 2½-pound cans, 40 cents; 5-pound cans, 75 cents. Prices of No. 2: 1¼-pound cans, 20 cents; 2½-pound cans, 35 cents; 5-pound cans, 70 cents. Prices of No. 3: 1¼-pound cans, 15 cents; 2½-pound cans, 30 cents; 5-pound cans, 60 cents. Only two brokers objected to the price; but after tasting the goods and seeing the quality, nothing more was said about the price.

I was told on two occasions, "No prune grower or packer ever had the nerve to come East and name a price for his goods." I was also told, "If I stayed by my price, and if I could pack prunes like the sample shown, that I had the coming goods." With an article like sample and backed up with a guarantee to not sugar-coat, mold, or get wormy and not to shrink in bulk in any country or climate, California could never grow enough of prunes to supply the Eastern market.

The price on the can has been a fixed matter for over two years. I have been in correspondence with brokers all over the United States, Canada, and Europe during the last two years. Only one broker made any objection to the price on the can commercially, and he said, "It did not interest him. Let the retailer and the consumer fight it out among themselves."

The Southern Pacific and Santa Fé have given me a rate of $15 per ton, which is a saving of $100 per car over box rates and $140 over bag rates. With these advantages it has been no trouble to make a fixed price. The broker and the jobber both say, "With your fixed price, we will have something we can tie to. But under the present system we do not know where we stand." They said, "This season opened with everything in favor of a 3-cent bag basis. We bought freely at that price, but almost before we knew it prunes were offered at a 2½-cent box basis. In consequence, we are heavy losers."

The commercial packer will tell you that the Eastern retail grocer will not handle California prunes for less than 100 per cent on his purchase price. After seeing the conditions under which he has to get that 100 per cent I do not blame him. His losses are great; he can not do otherwise.

With my proposition, the f. o. b. price is just half of the retail price. Now, for example, we will take a case of 2½-pound cans, No. 1. The f. o. b. price is $4.80 for 60 pounds net, or 8 cents per pound. The railroad will get 57 cents, the broker will get 27 cents, the jobber will get 81 cents, and the retail grocer will get $3.15. The grocer makes 50 per cent on his purchase, and has no loss. The consumer is not paying any more for his goods, and certainly gets an article of better quality.

What will the grower get? To make a long story short, he will get, if he does his own packing, a straight 4-cent basis.

Now, as to the system. It is simply this: The prunes are packed 85 per cent dry, in hermetically sealed cans, without exhaustion, *and then sterilized*. So simple; nothing more, nothing less. Prunes have been packed in tin cans for years, but no one ever thought of sterilizing them after they were packed. This is the secret of the whole matter.

Now, what has the grower to do? First of all, stop making quantity, and work for quality only; the average grower does not take the care and pains he should in drying his crop. All over the State of California too many growers are leaving too much wood on their trees. I have noticed some orchards that have twice as much wood as should be on them. Such orchards produce a large quantity of small prunes. It would be far better to have 80 pounds of 40's than to have 160 pounds of 80's, per tree. In our drying we too often do not have our dipping fluid hot enough, and the result is we have too many tobacco-colored prunes that take a long time to dry, and when they are dry are of a very poor quality and are not fit to be graded as first-class prunes.

When I was asked to read a paper on this subject, I at first hesitated, but the thought occurred to me, "send to Hanford and get some prunes." After some correspondence, your Mr. W. A. Long sent me a lot, and these prunes are here in the hall on exhibition, and I have a jar I will open and you can test them.

As I said in my opening remarks, why should the San Joaquin Valley prune-growers advertise the Santa Clara Valley prunes. Stop this foolishness and call your prunes "Hanford Prunes." Has anybody ever said that your raisins, peaches, or apricots are of a poor quality and do not contain enough of sugar? Then why are your prunes quoted at a discount? Ponder over this matter before another season.

PRESIDENT COOPER. "Report of Fruit Distributors," by Hon. Alden Anderson, which will be read by the Secretary.

REPORT OF CALIFORNIA FRUIT DISTRIBUTORS.

By HON. ALDEN ANDERSON, Manager.

In compliance with request for a report of the fruit shipments from this State this year, I herewith give figures compiled by this company, the same being for actual carload shipments (not estimated ton cars) of fruit leaving the State.

The first carload of cherries (which variety of fruit opens the deciduous fruit-shipping season in California) was shipped on May 2d, and the last carload (apples excepted) of grapes was shipped November 28th.

The following gives total carload shipments, by varieties, except apples, which shipment is not finished yet:

Cherries	150	cars.
Apricots	16	"
Peaches	584	"
Plums	1,220	"
Pears	1,513	"
Grapes	2,050	"
Apples, to December 1st	669	"
Miscellaneous	22	"

There was an increase in shipment of cherries over 1905, but on account of the cold, late spring and late rains the shipment did not reach the average quantity.

The shipment of apricots was light, on account of the very short crop.

The shipment of peaches was less than one third of the shipment of 1905. This was occasioned somewhat by the short crop in California, but more particularly on account of the heavy crops in the Eastern peach-growing districts.

The shipment of plums was only a few cars less than in 1905, while that of pears was some five hundred cars more.

The shipment of grapes exceeded that of 1905 by some 450 cars. The weather for shipment of grapes was very satisfactory, but the cold, late spring held them back and they were late in ripening and maturing. When ripe they seemed to have a deficiency of sugar compared to normal years, and there was much complaint that they did not carry as well as usual.

Of apples, there has been to this date something over a thousand cars less shipped than for the season of 1905. This decrease was occasioned by the large apple crop in the East and the fact that many apples are being stored and handled locally.

Although not called for by the report, I venture to remind the Fruit-Growers' Convention that there has now been enacted into law substantially the recommendations made by the Fruit-Growers' Convention of San José in 1904, and telegraphed to the President and our Congressional Representatives, both as regards the increase of power and duties of the Interstate Commerce Commission and the operation and control of refrigerator cars by the transportation companies themselves.

With reference to the amended Interstate Commerce Act, I know of no disadvantageous condition that will apply to shippers of California because of its enactment to offset its advantages. When the law first went into effect some of the Eastern railroads declined to make diversions, or make back hauls when necessary to reach the main line for diversion purposes, but these incidents are, through the assistance and understanding of the matter by the initial transportation lines, being protected by publication in tariffs.

The new refrigerator cars that will be operated by the railroad companies are said to be very fine, and it might be well for this Convention to request that the department having charge of their operation be separate and distinct and independent from all other departments of the railroad, so that there will be no chance of having the cars appropriated for other transportation purposes when needed. If such action is taken, growers and shippers should always be assured of a sufficiency of good, clean cars at all times for fruit transportation purposes.

Notwithstanding the large Eastern crops of the current season the fruit season just closed has, on the whole, been a remunerative and prosperous one for the fruit-growers of California.

PRESIDENT COOPER. The Secretary will now read the report of the Committee on Transportation.

REPORT OF THE COMMITTEE ON TRANSPORTATION.

To the Chairman and Members of the Fruit-Growers' State Convention:

Your Committee on Transportation beg leave to submit the following report for your consideration:

CORRESPONDENCE.

SACRAMENTO, CAL., October 4, 1906.

MR. C. S. FEE, *Traffic Manager, Southern Pacific Company, San Francisco, Cal.*

DEAR SIR: Herewith please find clipping from San Francisco "Examiner" of this date. If the statements therein contained are correct they will gladden the hearts of the fruit-growers of California.

Any information you can give regarding the subject will be thankfully received.

Yours truly,

R. D. STEPHENS,
Chairman California Fruit-Growers' Transportation Committee.

Following is a copy of the clipping above mentioned:

"Beginning October 10th the Southern Pacific will make a twenty-five per cent reduction in the tariff on commodities shipped under refrigeration. * * * At present the charge of shipping perishable commodities is twenty-five per cent above the cost of shipments. This cost is to be annulled and perishable goods will be transported at the same rate as other goods which do not need the protection of a refrigerator.

"The results of the change of policy are numerous. California fruit can be bought at a much cheaper rate in Eastern states; larger shipments of fruit and other perishable commodities will also be encouraged. The reduction is wholly voluntary on the part of the railroads."

MR. R. D. STEPHENS, *1210 N Street, Sacramento, Cal.*

DEAR SIR: Your favor of the 6th instant. Our Freight Department advises me that the reduction of twenty-five per cent referred to affects the Southern Pacific lines and is purely a local question in which our connections are not interested. It has been the practice to charge twenty-five per cent extra for fruit moving under refrigeration locally and this charge our Freight Department has decided to eliminate for the benefit of the industry.

Yours truly,

PAUL SHOUP.

SACRAMENTO, CAL., November 19, 1906.

H. A. JONES, ESQ., *Freight Traffic Manager, Southern Pacific Co., San Francisco, Cal.*

DEAR SIR: Herewith please find clipping from Sacramento "Union," stating that the Southern Pacific Company had contracted for 6,000 refrigerator cars to be used in the transportation of California fresh fruits to Eastern markets, etc.

Is the statement correct? If so, when will the cars be put into the service?

For years the growers of California have asked the Southern Pacific Company to supply its own refrigerator cars and if the company is now going to do so, such action on its part will meet with the hearty approbation of the growers, for the reason that they *believe their interests will be greatly promoted thereby.*

In order that you may know how the fruit-growers regard *private car lines*, we inclose a copy of the report made by their Committee on Transportation, which was unanimously adopted at the State Fruit-Growers' Convention at Santa Rosa last December, and, in substance, at all former conventions held within the last five years.

Never in the history of fresh fruit shipments made from California has there been so much complaint made regarding the impaired condition in which a large proportion of the shipments arrived at their destination.

The reports read, "Some wasty," "A good deal wasty," "Some rot," "Rotten," "Condemned by the Board of Health."

In the latter case, there was an additional charge made for "dumping," which, when added to all the other cost of growing, packing, and transportation, means a loss to the grower of from $1,000 to $1,100.

There is no disposition on the part of the fruit-growers of California to unnecessarily antagonize the Southern Pacific Company. On the contrary, they are anxious to be placed on the most friendly terms with it, and will do all in their power to bring about such a result.

Any information you can give our committee regarding the subject of this inquiry will be reported to the fruit-growers at their next annual convention to be held at Hanford, December 4-7, 1906.

Yours very truly,

R. D. STEPHENS, Chairman.
W. W. PHILLIPS.
A. N. JUDD.
R. I. BLOWERS.
ALEX. GORDON.

SOUTHERN PACIFIC COMPANY—PACIFIC SYSTEM.
H. A. Jones, Freight Traffic Manager.

SAN FRANCISCO, November 24, 1906.

MR. R. D. STEPHENS, *Sacramento, Cal.*

DEAR SIR: I beg to acknowledge receipt of communication of the 19th inst., signed by yourself, W. W. Phillips, A. N. Judd, R. I. Blowers, and Alex. Gordon, and in reply desire to say the Harriman lines have ordered 6,000 refrigerator cars, of which 600 are to be delivered on December 1st, and the balance at the rate of 1,200 a month, beginning January 1st, which they propose to operate under their own management. From this you will understand that we will have a sufficient supply in time to handle the next crop of deciduous fruit.

It will probably interest you to know that these cars are to be much larger than those now in use. The outside length is 41 feet 10 inches. The distance between ice-tanks is 34 feet 3¾ inches. In height the cars will be 7 feet 6 inches, with a width of 8 feet 2¾ inches. This available cubic capacity is 2,119 cubic feet.

As compared with the cars now in use, these new cars are 1 foot 10 inches longer, nearly 2 feet wider, and have nearly 200 cubic feet more available space. They will also have capacity for one ton more ice than the present cars.

I would be pleased to have your committee transmit this information to the fruit-growers at their next annual convention to be held in Hanford, December 4th to 7th.

Yours truly,

H. A. JONES,
Freight Traffic Manager.

SACRAMENTO, November 30, 1906.

MR. H. A. JONES, *Freight Traffic Manager Southern Pacific Co., San Francisco, Cal.*

DEAR SIR: Your favor of the 24th ult.—in reply to our communication of November 19th, asking for information regarding the statement published in the daily papers that the Southern Pacific Company was making arrangements to put on an equipment of refrigerator cars of its own, sufficient in number to successfully handle all California-Eastern fruit shipments, confirming the report—received.

That the fruit-growers of California will fully appreciate this action on the part of your company there can be no doubt.

That the growers for the best of reasons have been diametrically opposed to private refrigerator car lines is demonstrated by the repeated action taken by them in their State Conventions in the past.

The reasons that prompted the growers to take such action were, that they believed and felt confident that the private car line was a menace to their interests, and also a menace to the best interests of the State, and that by its elimination much good would come to them and to California.

Now that their prayer has been granted they feel that their interests will be better protected, through more attention being given to the proper handling of their shipments, in the way of icing and attention given to the proper condition of the cars.

What the fruit-growers of California ask for more than anything else, is, that all who are interested, and engaged in growing and shipping fruit, shall be placed upon an equality.

They are opposed to the granting of special privileges to any one as being inimical to the best interests of all concerned.

Thanking you for the information you so kindly gave, I remain,

Yours truly, R. D. STEPHENS,
Chairman Fruit-Growers' Transportation Committee.

STATEMENT

Showing Shipments of California Deciduous Fruit, and how Distributed in Eastern Auction Markets.

From July 14 to October 20, 1905, there were 3,066 cars of California deciduous fruit sold in the Eastern auction markets, and in 1906, for the corresponding period, 3,619 cars, or 553 more than in 1905.

There were 1,267 cars of California fruit sold in New York, 902 cars in Chicago, and 605 in Boston, making a total of 2,774 cars, leaving 845 for the other ten auction markets.

There were 253 more cars sold in New York this year than last year, 158 more in Boston, and 105 in Chicago, making a total given for New York, Boston, and Chicago of 516 cars, leaving a gain of only 37 cars for the other ten auction markets.

There were 1,580 cars of deciduous fruit sold in New York altogether from the 14th of July to the 19th of October; 313 of these cars came from Washington, Oregon, Idaho, and Colorado.

Up to October 17th, this year, there were 5,456 cars of deciduous fruit shipped, and to the same date last year 6,819 cars, showing that there were 1,363 more cars shipped last year than there were shipped this year up to an even date.

The time made in the transportation of California fruit from about the 15th of October to the close of the season was very unsatisfactory. It varied all the way from 14 to 20 days on the long haul, many cars being out 16 to 18 days.

For some reason, which has not yet been satisfactorily explained, a very large proportion of the fruit shipments arrived in poor condition. It was reported "wasty," "much wasty," "a good deal of rot," "rotten," and some of it in such a bad condition that it was condemned by the board of health.

If the cause of the decay in the fruit is one that can be controlled, it may not be one of much concern, but if it is attributable to deterioration in the keeping qualities of our fruit, then it is a very serious matter, and portends no good to our horticultural interests.

It is a matter that should be thoroughly investigated both by fruit-growers and the transportation companies.

Respectfully submitted. R. D. STEPHENS,
Chairman of Committee on Transportation.

MR. R. D. STEPHENS. Now, Mr. President, Ladies and Gentlemen: There is much between the lines, and particularly in regard to the distribution. It seems that there were five hundred and odd more cars sold in three cities than there was last year, with about 1,300 cars less shipped during the same period. All the statistics contained in this report correspond with like periods of last year and the year before. They are for corresponding periods, and it seems rather singular that with less shipments there should be so many more cars placed in the same markets. A great deal was absorbed by the auction markets in Canada, that is, Toronto and Montreal, where there were 153 sold this year against 103 last year, leaving for the other nine markets a deficit. There is something peculiar in the other nine markets. For instance, in Cincinnati and other markets, for a whole week there is not a carload of California fruit sold. That is something peculiar.

Now, regarding the condition in which the fruit arrived at destination. The first part of the season better time was made and the fruit arrived in such a condition that I heard of no complaints, generally speaking. Some claimed that the keeping qualities of the fruit were impaired in consequence of the late spring rains. It seems to me, if that theory is correct, that the first shipments of the season ought to have gone forward and arrived in a much more impaired condition than the later shipments that had the dry air and hot weather in which to mature. However, that is something which we don't know anything about at this time. We do know, however, and we base our hopes in the future for improved conditions upon the fact, that the Armour Company is going out of business, and it is possible it may not have given the care and attention to the later shipments that it ought to have given. There is one thing certain, that if the decay is attributable to the condition in which the fruit was packed, in other words, if it was the impaired condition, it does, as stated there, portend no good to the State of California.

Now, in regard to time. There were many cars out eighteen days. Why, I do not know. The time, as I stated, in the first part of the season was better than in the last. Some cars were out twenty days. That is a long time. There should be better time made in the close of the season in shipments of grapes, for the reason that necessarily their keeping qualities must be somewhat impaired either by rain or by frost. It seems universally to happen that, at the close of the season, the worst time is made by the railroad companies. They make better time in the beginning of the season than they do in the last.

Another thing: The car lines may think it unnecessary to put in large quantities of ice because of the fact that the weather is cool. When the fruit is in an impaired condition, it needs more attention than it does at any other time, and if they ever fill the tanks with ice they should be filled during the last shipments. The fruit stands in more need of it then than it does at any other time. One of the peculiarities about it is, that when we could get what was called a ventilator car, those used in early days, five or six or seven years ago—I think they were built by the Southern Pacific and the Union Pacific—the fruit arrived in better condition than it does in the refrigerator car. The explanation may lie in the fact that the refrigerator iced car is sealed up. No air can pass through it at all, and unless it is fully iced, it is like an oven, and of course the contents would arrive in a much more impaired condition than they would if the air was passing through.

That is about all we have to say, with the exception that we feel that any improvements in the transportation of our fruits to Eastern markets made by the Southern Pacific, or by any other company, should be encouraged. We don't want to get into a contest with the railroad company if we can help it, and we will not if they take the proper care of our products. Therefore, the committee felt that it was the duty of the fruit-growers of the State of California to give a vote of thanks to the Southern Pacific Company for putting on its own refrigerator cars. What we look forward to as being beneficial to us is the fact that the railroad company will be responsible directly for the handling and management of those cars. I don't agree with Lieutenant-Governor Anderson regarding the suggestion to segregate it and make it a different and separate institution. I believe that the officials of the Southern Pacific should be held responsible for any dereliction of duty. It will be much better than to make a separate department and let that department handle it, because then the Southern Pacific officials will say, if anything happens, that it is the fault of the other department. In case it is not properly handled or does not arrive at destination in a proper condition, you can go right directly to the officials of the Southern Pacific Company. Therefore, I believe that the management of these refrigerator cars should lie directly with the officials of the Southern Pacific Company.

In conclusion and in line with what I have said, I wish to offer the following resolution for the consideration of this Convention:

WHEREAS, Mr. H. A. Jones, Freight Traffic Manager of the Southern Pacific Company, has through its transportation committee notified the members of this Convention, that it will in the near future have an equipment of refrigerator cars of its own, sufficient in number to properly handle next year's deciduous fruit shipment; therefore, be it

Resolved, That a vote of thanks be tendered the Southern Pacific Company by this Convention for its action in supplying such cars for the purpose above mentioned; and be it further

Resolved, That all the future acts of the Southern Pacific Company that will result in fostering and promoting the legitimate and equitable interests of the fruit-growers of California will be heartily welcomed and fully appreciated, for the reason that the future welfare and prosperity of California mainly depends upon a much greater development of its almost unlimited horticultural resources.

MR. JUDD. I move that the rules be suspended and the resolution be immediately adopted.

Motion seconded.

The question was put on the motion to suspend the rules, and carried.

The question was then put on the adoption of the resolution.

MR. SPRAGUE. Mr. Chairman, as Lieutenant-Governor Anderson is not here, I beg to correct the impression which Mr. Stephens has concerning his recommendation in that paper. Having talked the matter over with him, I know that it is his view that the interests of the fruit shippers of California will be better served in the matter of refrigeration by the Southern Pacific following the method of the Santa Fé and creating a special department—not an outside company having no relation to nor control by the officers of the Southern Pacific Company, but a special department of car refrigeration—for the reason that then there will be some particular man whose interest it is to look after the refrigerator business to see that the cars are properly furnished and the icing is done and all that sort of thing, instead of leaving it to the general operating department. I have no doubt but what this will be the better method, and, in fact, it is the method which has been already adopted by the Southern Pacific. Mr. J. M. Seacrist is the new manager of the Southern Pacific refrigerator line, and he is laying plans, I may say, for an entirely new departure and a greater improvement in refrigeration than has ever before been made. There is certainly great promise for getting our products through with better satisfaction in general than they have ever been transmitted as yet.

There is another point. Had it not been for the universal congestion on the railways during the last few months, I should certainly be in favor of severely criticising the fact that our grape shipments during the latter part of the year have been so delayed that it has been a very serious matter. We have the right to complain of both railroad companies; but they say that this is only a part of the general burden, and that all traffic has been congested. But we certainly should not tolerate any customary delay of that kind.

MR. STEPHENS. I desire to explain my position. The objections that I have are to making it a separate concern. Of course it must necessarily follow that some Southern Pacific official take charge of this matter, but I want him to take charge of the refrigerator cars in the name of the Southern Pacific and not in the name of any side company. One of our great evils, and one of the evils of the fruit-growing interests of California, has been rebates. The manager of the Santa Fé refrigerator cars testified under oath before the Interstate Commerce Commission that he gave a $25 rebate on the long haul and a $25 rebate to Chicago and like destinations. We don't want anything of that kind. We want the Southern Pacific Company to be responsible for the management of these cars. We want them managed by that company and not by any side company. Now, since that question has been raised, it was heralded through all the newspapers in the State that there was to be a great reduction made in refrigeration for the past year. Taking into consideration the rebates paid by the Santa Fé, which the manager stated under oath he had made to meet the competition of the Southern Pacific (and therefore it is reasonable to assume and deduce from his evidence that the Southern Pacific Company paid like rebates)—Mr. Sprague refers to shippers. I assume that the growers should be considered as well as the shippers.

MR. SPRAGUE. I consider the growers are the shippers. It is their fruit.

MR. STEPHENS. It is their fruit, but they have no more say about it than the man in the moon in nine cases out of ten under present conditions. Instead of being a reduction it was a raise, considering rebates given, of $17.50 on the long haul in the case of refrigeration, to the shippers, at least, and a raise of $15 to Chicago. As a matter of fact, the ostensible cut was more than covered by an increase in rates. In all shipments to Chicago it cost the growers $3 more this season, including the reduction, to land a car of fruit in the city of Chicago and like destinations than it did last year (1905). There was a reduction of $1.40 on the long haul, but that did not cover the raise of $17.50 which was made in the rate, considering rebates. If there is anything that is ruinous to the horticultural interests of this coast, it is rebates, and we want to cut them out. We want the Southern Pacific Company to be responsible for the management of these cars. (Applause.)

MR. MARK L. McDONALD. If there are any prune-growers here, I hope they will remain and discuss this question with me. It certainly is one of great importance. I consider the matter of fixing the price of prunes as equal to that of transportation. The gentleman stated in his paper on prunes why it is we are suffering so much and getting so little for our prunes. If you will remember, he remarks in his paper that prunes from other places are being sold as Santa Clara prunes. Now, that is unfair, that is unjust, and it should be remedied. Aside from that, we should get together. The prune-growers should get together and do something to see if we can not get a better price for our prunes. And in view of that I will offer a resolution which will bring the matter before the Convention.

I move that the Chairman of this Convention be authorized to appoint, at his earliest convenience, a committee of five, whose duty it shall be to take measures looking to the organization of the prune-growers of this State, and that such committee shall take immediate action.

MR. JUDD. I move to suspend the rules and move the adoption of the resolution.

Motion seconded.

The question on the suspension of the rules was put, and carried.

MR. SPRAGUE. Now, is the question on the adoption of the resolution open for discussion?

PRESIDENT COOPER. Yes.

MR. SPRAGUE. It will not be effective to adopt this resolution. Mr. Bowers has suggested a method for getting at a remedy, and I am inclined to put considerable confidence in his method. I believe some of you with a little money should get back of Mr. Bowers and put up these prunes just as they ought to be put up, with a price on them, and then get them to the East and sell them. Then send forward four times as many and sell them. Then you will bring out a remedy for the evils that beset us. Not for many years will we be successful in appointing a committee of three or five to organize the prune-growers. Let us do something a little more practical.

MR. McDONALD. I suggest that Mr. Bowers be placed on this committee.

MR. SPRAGUE. If that is what it means, I will vote for it.

MR. McDONALD. Yes, I would like to have him on the committee.

PRESIDENT COOPER. We have one more paper, which is entitled "The United States Plant Introduction Garden, and its Value to California," by Roland McKee.

THE UNITED STATES PLANT INTRODUCTION GARDEN, AND ITS VALUE TO CALIFORNIA.

By ROLAND McKEE, of Chico.

You undoubtedly all are aware that at Chico, in this State, is located what is known as the Plant Introduction Garden of the U. S. Department of Agriculture, and most of you, perhaps, are more or less familiar with the history and general character of this institution. However, we have endeavored to bring together data that may perhaps be of interest and at the same time lead to a more perfect understanding of the work being carried on at the garden and its value to this State.

The Plant Introduction Garden was established by the Honorable Secretary of Agriculture, through Dr. B. T. Galloway, Chief of the Bureau of Plant Industry, in 1904. The object in establishing the garden was not to found an experiment station for the State of California, but to establish a garden where importations of seeds, cuttings, scions, buds, and plants in small quantities could be cared for and propagated for further experimental purposes. Thus, the immediate cause that justifies the maintaining of this institution is found in the fact that men of the Department of Agriculture, specializing in definite lines of work, find that it is most essential that they have some place where they can send material for propagation, care, and preliminary testing. This, of course, applies more particularly to new introductions that are being sent from various parts of the world, but is also true of all new introductions.

Formerly this work was carried on in the greenhouses at Washington, but they became inadequate for the demands made upon them as the volume of work with new introductions increased, therefore the garden at Chico was established to fill this need, and thus far it has proven quite satisfactory. Conditions at Chico are quite favorable for the accommodation of a wide range of plant growth, and we find at the Plant Introduction Garden plants from widely separated parts of the world succeeding quite well.

The work at the garden is broader in its scope than one not entirely familiar with the institution might imagine. Many lines of investigation are being carried on. Seeds, cuttings, scions, buds, and plants from all parts of the world are being introduced, propagated, and tested. By introduction, breeding, and selection we are endeavoring to discover and develop plants suited to particular soils and climates and that are less susceptible to adverse conditions; to improve varieties both as to quality and quantity of fruit produced.

We wish to mention briefly the more important lines of investigations being carried on at Chico and to call attention in particular to a few lines of work that may possibly result in immediate benefit to this State. The purely agricultural investigations may not be of immediate interest to this Convention; however, we wish to call attention briefly to this line of work, that you may get a better idea of the full scope of the work we are carrying on.

Some five hundred varieties and selections of grasses were grown at the garden the past season as preliminary work in the testing of this class of plants for the hay and pasture. The problem with the grasses, in so far as California is concerned, is readily resolved into three lines of investigation: the securing of a plant that will withstand continued drought and extreme heat; the securing of a plant that will make good winter pasture; and the securing of a plant that will make sufficient growth under irrigation to be of value. In working to this end grasses from all parts of the world are being secured and we now have growing at the garden a number of grasses that are recent introductions from South Africa, India, Australia, and China, together with many introductions from various other parts of the world. Some of these give promise of being of interest and value to the farmers and stockmen of this and other states.

Quite extensive investigations are being carried on with the Medicagoes, including principally the alfalfas and bur clovers. A number of varieties of alfalfa are being grown to determine the relative value when grown with and without irrigation. One variety in particular is showing up remarkably well as a variety to be grown with irrigation, and our work thus far indicates that, during the season, two crops more can be cut of this variety than of the ordinary alfalfa. However, while it has been observed that this variety makes a much more rapid growth than does the ordinary alfalfa, it has also been observed that the hay of this variety weighs lighter than that of the ordinary alfalfa. Whether this variety will produce more weight of dry hay than will the other varieties has not been determined; however, we are of the opinion that this will be the case. The variety referred to is known as the Arabian alfalfa and should be of interest to farmers and stockmen of this as well as other states.

The work with the bur clovers is quite promising. Nearly all the species of the genus are being tested and thus far some are giving promising results. We are in hopes of finding among these a variety or species that will make a good range pasture plant for cattle and sheep. We have several varieties growing at the garden that give promise of serving this purpose. The varieties referred to are strong growers and produce seed in abundance. The burs are entirely spineless and are from one half to one inch in diameter, being of course considerably flattened.

Seed of these varieties was secured from Algeria through Mr. C. S. Scofield. Thus far, while making preliminary tests with these, our aim has been to secure seed in sufficient quantity that they might be given a fair test on the open range. In another year we are in hopes of having seed of these in sufficient quantity that they may be fairly tested as range pasture plants. (Sample of seed shown.)

A line of work being carried on particularly for California is that of investigations with Indian corn. The past season thirty-one varieties of corn were grown at the garden to determine their relative adaptability to the conditions of this State. Aside from the variety tests selective work was begun with a hybrid variety that gave promising results in the tests of 1905. Mr. C. P. Hartley, who is in charge of the Indian corn investigations, writes that he is quite hopeful of materially benefiting the California farmer by work in the selection and adaptation of corn varieties to the conditions in California.

The work with the legumes should be of special interest to both the agriculturist and horticulturist of this State. At Chico our work with this class of plants has been and will be more extensive with the Vicias, Pisums, and Lathyrus. This year we are growing ninety varieties in these genera. We are endeavoring in this work to find the best plants to grow for either a summer or a winter crop, to be plowed under for green manure. That such practice with this class of plants is of inestimable value to every class of fruit-growers as well as to the farmer is being more generally realized. The more progressive fruit-growers of this State have come to realize the advantages in the increased size, quality, and quantity of fruit, attained by the use of a leguminous green-manure crop as a fertilizer and soil renovator, and are using them to quite an extent. I am also pleased to say that some are carrying on their work with the view of aiding in the finding of better or improved crops for this purpose. However, there is a great part of the State where the value of this work is not realized and in such sections what might easily be is not attained. Some of the most promising crops for green-manures for California, so far as our work indicates. are *Vicia bithynica*, *V. atropurpurea*, *V. sativa*, *V. fulgens*, *Lathryus coccineus*, *L. tingitanus*, together with the Pisums, a number of which do well.

Work is being carried on in testing varieties of cowpeas, soybeans, and various *Phaseolus* sp., and while not intended for California alone this work can not help but be of first value to this State.

Some three hundred varieties of sorghums were grown at the garden the past season. These were introductions from China, South Africa, Abyssinia, together with varieties of this country. From the fact that California's climatic conditions are such as to make a forage crop that can be grown during the dry season without irrigation desirable, it is possible that this class of plants, already famous for their drought-resistant qualities, and to a greater or less extent already grown in this State, may furnish something of value.

Quite extensive investigations with cacti, under the direction of Mr. David Griffiths, are being undertaken at Chico. Some two hundred and fifty types are being grown with which breeding and selection work will be carried on. The object of this work is to secure, if possible, varieties that will be of value for stock food on the ranges and drier regions of the United States; also for ornamentation and the production of fruit for man. Quite a market has already been established in the Eastern cities for the fruit of this plant, which is now almost wholly imported from Mexico and other countries. (Photos shown.)

Another plant of especial interest to the agriculturists is the guar (*Cyamopsis psoraloides*). This is a kind of bean that was secured in India. This plant is exceedingly drought resistant and gives promise of being a good crop for both fodder and seed. In India the guar is used by the natives as a vegetable. This year, sown at the garden the latter part of June, it made a growth of from three to five feet in height and has set a heavy crop of seed without irrigation and on land not subirrigated. We are very hopeful for this plant and think it will be of value to California, as well as to other parts of the arid regions of the West. (Seeds, plant and photos shown.)

I wish here to mention a few of the more important lines of work that are of immediate interest to the horticulturist. The more promising introductions of this class were discussed fully by Prof. P. H. Dorsett yesterday in an address before the Nurserymen's Convention, which many of you attended; however, we wish to call attention to this work in a general way, dwelling more particularly upon lines of investigation not discussed in that address.

The past year we have carried on considerable work with vegetables. This consists in the testing of varieties comparatively to ascertain the relative value of new varieties and to determine the trueness to name and type of both old and new varieties placed on the market by the various seed firms of this country and to ascertain their adaptability to California conditions. A very interesting collection of Turkestan muskmelons was grown at the garden the past summer. These were importations from Turkestan, and some of them apparently are valuable melons.

The Udo salad plant (*Aralia cordata*) has been grown at the garden for two years. This has not been tested here as to its quality as a vegetable, but has been grown in quantity for distribution and testing elsewhere. However, from all information attainable this promises to fill a place in the list of salad plants that will be distinct in itself. The udo is a winter vegetable, being in season from October to May. This is an introduction from Japan and is said to be crisper than celery and to have none of the objectionable stringy fiber that is often found in that plant. It is used both in a fresh state as is the celery and is also cooked in various ways. From the fact that this plant is adapted to winter culture it might be made a profitable crop in some parts of this State as well as in many other parts of the United States. The udo is discussed quite fully in Bulletin No. 42 of the Bureau of Plant Industry. (Plants and photos shown.)

The pistache, of which a number of thousand plants have been grown at the garden, gives promise of being the means of establishing a new industry in this State. The pistache is a tree attaining considerable size and produces a nut much prized in many markets. The large pistache is used as we use the almond. The nut is now imported at a high price for use in confectionery and also as a table nut. The tree has the advantage over the almond of being a late bloomer and is somewhat more drought resistant. California should be able to produce this nut in sufficient quantity to supply the American market, as it is thought to be well adapted to various localities of this State.

The garden is in possession of one of, if not the finest and most extensive collections of figs in the country, to which additions will be made the coming season and thereafter whenever it is possible to find new varieties. These are in permanent plantings and are to be used in connection with selection, breeding, and testing of varieties. Those who have given the fig industry any study know that much is yet to be accomplished in connection with this work, and California will be almost alone in reaping the benefits of these investigations.

Viticultural work is also receiving considerable attention. Plantings of a permanent vineyard have already been begun, and it is expected that within a few years nearly every known variety of grapes will be represented in the collection. Here, breeding, selection, and other investigations will be carried on, supplementing the work of the other viticultural stations to be found in various parts of the State. The value of this work to an industry represented in this State by possibly 75,000 acres of permanent plantings should be apparent to all and should receive the hearty support of every one who is at all interested in the welfare of this industry.

The Japanese paper plant (*Edgeworthia papyrifera*) is an introduction from Japan that is receiving considerable attention. This is a small, upright-growing shrub the bark of which is used in the manufacture of paper. A number of thousand of these plants have already been grown at the garden and distributed for further testing. Investigations with this plant have not been extensive enough to say as to its probable future; however, it may possibly be of value.

Another line of work that is of possible value to this State is that with the rush (*Juncus effusus*) or matting grass, from which the matting of commerce is manufactured. The entire supply of raw material for this purpose is now imported. This work, under the immediate supervision of Mr. John Tull, is being carried on particularly with the hopes of being able to establish this industry on the abandoned rice lands of the Southern States. However, it seems probable, if work with the Juncus is made to succeed, that some of the low waste lands of this State might be profitably used for this purpose.

A number of other very interesting lines of work might be discussed, but time will not permit. We will, however, mention the work with the carob (*Ceratonia siliqua*), a tree which produces a bean which is said to be of unexcelled quality for stock feeding, and the tree itself is also quite ornamental. We wish also to call attention to the Kai apple (*Aberia caffra*), an introduction from the Cape of Good Hope, which gives promise of being an unexcelled hedge plant. It also produces a fruit which makes an excellent jam, marmalade, sauce, and jelly.

We have but mentioned some of the more important introductions and lines of work that are being investigated at the Plant Introduction Garden, but we trust we have given you somewhat of a general idea of the work and its importance. More interest in the work on the part of the people of California would not only be a benefit to the State itself, but would also greatly help the work. Of course, you will understand that most of this work is yet in the experimental stage and our remarks have been made from data secured by men who have seen these plants growing in their native soils, and the indications for success as shown by the very limited work with them at the Plant Introduction Garden. We do not mean to say that any of these introductions are entire successes, for work with them has not been extensive enough to warrant any such conclusions, but we do say that they are worthy of being given your closest attention. You all realize that the agriculturist and horticulturist work in the face of many disadvantages. Thus it certainly behooves one to appropriate to one's self every advantage offered and to try and increase one's profits by better methods and better stock, and it is to this end that the Plant Introduction Garden is trying to assist.

We are also endeavoring to aid in the work of introducing new plants of whatever kind that may be the means of establishing new industries or of adding to the value of ones already established. Our constant aim is to help the agricultural and horticultural interests of the country in general, and we trust we will have the hearty support of all.

(At this time an adjournment was taken until 9:30 o'clock to-morrow morning.)

PROCEEDINGS OF FOURTH DAY.

FRIDAY, December 7, 1906.

The Convention was called to order at 9:30 A. M. President Cooper in the chair.

PRESIDENT COOPER. By special arrangements, Professor Waite is to make remarks this morning on peach blight, but until the audience gets settled we will take up the essay of Mr. Berwick. Mr. Berwick has written that he will be unable to be present and has requested that his paper be read by the Secretary. Mr. Isaac will now read Mr. Berwick's paper.

THE FRUIT-GROWER AS A FACTOR IN POLITICS.

BY EDWARD BERWICK, OF PACIFIC GROVE.

Factors are of various kinds. There are prime factors, and there are negligible factors.

The horticulturists of California are the class that produce the greatest amount of its wealth. They are prime factors as contributors to the economic upbuilding of the State. Are they prime factors in the directing of its politics? Or are they not only negligible but also wholly neglected factors in this respect?

When it comes to taxation they are prime factors as taxpayers; but when "political pie" is to be divided they become once again negligible.

Even the party platform usually ignores, if it does not actually antagonize, the fruit-grower's interests; and, should he presume to ask his candidate for Congress to pledge himself to further certain specific measures devised for the general benefit, he is met with the rebuff that it is a misdemeanor for the candidate to so pledge himself, or for any voter to ask such a pledge, and is referred to Section 55*a* of the California Penal Code.

Why is this thus? Why is the magnitude of the horticultural industry thus slighted?

When Shakespeare wanted Coriolanus to express his contempt for the disunited citizens of Rome he put into his mouth the words, "Go, get you home, you fragments." Note the word "fragments"—"you fragments." Is that what is the matter with the horticulturists? Are they still simply "fragments"—disunited—a prey to every other class?

The merchant has his Merchants' Association to protect and preserve the rights of his class. The lawyer has his Bar Association to decide on the minimum fee in which his client shall be mulcted. The railroad representatives gather harmoniously and decide just how much the traffic will bear. The lumber trust brings together all the mill-owners to raise the price of box material. The very laborers' union seeks to dictate hours and prices to the employer. All are learning that in union there is strength. But the horticulturists remain "fragments." The greatest industry in the land the least organized! The greatest industry in the land, and probably not a single representative in Congress! When a new Senator has to be chosen does any one dream of consulting the fruit-growers? "What Herrin says" heads columns in the newspapers, and what Herrin says almost invariably goes. Herrin runs the machine, and the fruit-grower is hardly permitted to be a cog in that machine. He's simply a "fragment."

Even commercially, whether buyer or seller, he is usually a "fragment"—a prey to every organized body. Price lists, specially arranged to hoodwink the farmer, are printed. His local merchant makes him believe that when he is getting his goods at San Francisco catalog prices he is doing remarkably well. Nothing is said of the discounts, and cash discounts, perhaps ranging from 25 to 75 per cent off the catalog "list." If the farmer would cease to be a "fragment" and learn to coöperate with his fellows he could pocket these discounts himself instead of being mulcted by the other fellow. For instance, why should not fruit-growers organize a coöperative lumber-mill to cut their own box shooks? In selling, it is the same. The farmer frequently does not know what his own product is worth in the world's market. The buyers belong to merchants' associations, or produce exchanges, that enable them to keep posted on values. The growers, who, if united, would be kings of the situation, act simply as "fragments," disassociated, and let the buyers fix prices of the growers' produce.

What obtains in the world of commerce obtains yet more remarkably and unmistakably in the political world.

Here again the horticulturist is a "fragment." Of pooled issues he will have none. He sees transportation companies pooling political issues and bemoans and bewails that they dominate the field, getting all they want for themselves, and all the "pie" for their faithful henchmen. They know what they want, they go for it, and they get it. The bread they cast on the waters of the political pool always comes back buttered; *not* after many days, it comes back right away.

The fruit-grower is just the reverse. He is not even quite sure what he wants. He won't even try to put in his spoon to stir the political pot. Why, he won't even spend a dollar two or three years in succession to agitate for a parcels post, which would do wonders toward making him commercially and financially independent. He won't even take the trouble, as a rule, to write to his own representative in Congress at Washington to tell him what his views are on a subject of such transcendent importance. And yet it is the lack of action on the part of Congressmen that delays the inauguration of this enormous boon to all classes. Both President Roosevelt and the Postmaster-General have intimated their wishes in the matter, by making the present domestic rates look ridiculous. Those two officials dominate the foreign postal conventions. By their action they have made it possible to send a four-pound parcel from Hanford to Great Britain for 48 cents, while it still costs 64 cents to send the same parcel from Hanford to Fresno. Four cents a pound *more* from Hanford to Fresno than from Hanford to London. If that is not too utterly silly and ridiculous, what is ridiculous? The reason is that Congress dominates domestic postage and railroads dominate Congress. Being simply "fragments," we permit our own representatives to tax us in order to pile up $31,000,000 surpluses for express companies. So it was fifty years ago, so even now:

"Its notorious in town
That our own representatives do us quite brown."

Some of them join in the chorus raised by the express companies in the subsidized press that an up-to-date domestic parcels post would ruin the business of local merchants. They have sung this so loud that there are actually some local merchants fools enough to believe it. Fancy, fools enough to believe that better and cheaper transportation would ruin the world's commerce. Why, if there be any science of commerce, it consists in bringing producer and consumer as closely together as possible, and this has been done all through the world's history by increasing transportation facilities.

Half a century ago the great Macaulay wrote that, "barring the alphabet and printing-press, those inventions which abridge distance have done most for the progress of mankind." The parcels post practically abridges distance.

But to show the silliness of this contention as to the retail merchant I will give two illustrations.

Many of California's most prosperous towns and villages are within a 100-mile radius of San Francisco. The principal department stores in San Francisco already send goods from their bargain counters *absolutely free of all freight charge* to customers living within the 100-mile radius. According to the express company's argument this should have ruined the business of local merchants in that radius. Is this so? Its utter falsehood can easily be established by visiting San José, Oakland, Berkeley, Stockton, Petaluma, Sacramento, Santa Rosa, or any other place. It will be found that never were all stores in those towns better stocked with goods or doing a better business than to-day. If absolutely free delivery of goods has not proved injurious, what harm could a two cents per pound delivery do?

Furthermore, the lack of a parcels post often causes much loss of trade to the local merchant. Not only does he lack its convenience in enabling him to keep a wider variety of goods, to send direct to factories for these goods, and to replenish his stock more frequently and easily, but he loses in this way.

There are many things he does not carry in stock that his customer wants, say a pipe-wrench of 11 pounds weight. For the customer to get this from an Eastern mail-order house, there are only two ways: by express or railroad freight, as the postoffice will not handle domestic merchandise parcels over 4 pounds. By express the rates are almost prohibitive; by freight they are more reasonable, but the minimum charge by the railroads is for 100 pounds. What does the customer do? If his wrench is to come by freight he must pay on a full 100 pounds. He thereupon thinks, "Well, if I must pay for 100 pounds I may as well send for enough other goods to make up the 100 pounds," and proceeds to scan the catalog to see what he can send for to make up the additional 89 pounds. So in the end the local merchant loses a whole 100 pounds. Had there been an up-to-date parcels post the customer would simply have sent for the one article the local merchant could not furnish. Or, more likely yet, would have asked the merchant to send for it for him from the factory, where the merchant's trade discounts would permit of an ample profit being secured.

I have dwelt on this retail store argument rather fully because so much has been made of it in California, and the same twaddle was recently telegraphed, *as news*, from New York, where the silliness of the argument becomes too outrageous, seeing mail-order houses can already send packages near such big centers by rail at much lower rates than parcels post calls for.

Another point of vital interest to the horticulturist is the schooling of his children. He is just beginning to awake to the idea that he has a right to be heard in this matter, and that it should not be entirely left to such bodies as the High School Teachers' Association, or even university boards. There has been in the past a tacit acquiescence in the dictation of such bodies that is remarkable. As a result we have a school system based on the idea that the prime essential is to fit pupils for the university. We have also the ridiculous assumption that a knowledge of one or more dead languages is an indispensable requisite for our youth. Years ago the man with a capacity to sling a few quotations from Greek or Latin authors at an audience plumed himself on his superior "culture." He could have said the same things just as well in plain English, but that would not have exhibited the "knowledge that puffeth up." *Now* he *has* to say them in plain English, or be laughed at as a conceited pedant.

It has been fashionable to hold up the civilization of Greece as a model for us moderns. Well, the Greeks had so poor an opinion of any language but their own that they said that all others sounded like "Baa, Baa," and hence they called those who spoke them "barbarians." Perhaps we might follow their pattern, at least so far as to impart a thorough mastery of our own language in our schools rather than a smattering of dead languages.

The reason that schooling is free to all in America is to make this Government that most lovely and desirable thing: a government of a wise people, for a wise people, by a wise people; and not that most ridiculous and contemptible thing: a government of foolish people, for a foolish people, by a foolish people. Wisdom is what? "Wisdom is knowing what is best to do next. Skill is knowing how to do it. Virtue is doing it." Does the average pupil leave school equipped with wisdom, skill, and virtue, as thus defined? Is instruction in dead languages likely to furnish this equipment? Is it not entirely desirable that our youth should learn how to do things as well as how to say things? Could not a course of instruction be arranged that would interest children in the thousand and one things essential to a right understanding of life and how to live—things pertaining to self-maintenance and coming responsibilities as parents and citizens? Shall it be this, or shall we continue making their minds "perfect rag-bags of useless knowledge"?

The chief end set before pupils seems to be to "get credits" so as to "get on" in life. To "get on" is usually accepted as meaning to attain some position where it will be possible to exploit the labor of others: to avoid eating bread in the sweat of one's own brow by making the other fellow's brow sweat unduly. The more other fellows you can make sweat, the more you have "got on."

This is the basic idea that leads to all "graft" and malfeasance in office. Is it the basic idea of Republicanism or Cæsarism? Cæsarism exalts the one at the expense of the many. Up with Rogers and Rockefeller? Who cares for the rabble who toil? "Fragments!" "Fragments!" Is this the creed for your children? Or, shall it be that co-exaltation of the many, which is the essential core, not only of all worthy Republicanism, but of all true Christianity?

Gentlemen, it is for you to dictate which standard you wish upheld. To neglect this duty is to be a traitor to your much-loved country. The only way to keep this "the land of the free and the home of the brave," to keep this a real "government of the people, for the people, and by the people," is for each of us to be willing to do his share of governing, even at the cost of some little self-sacrifice. It is idle to complain of boss rule when this boss rule is made possible simply by our own neglect to attend to our own national business. Each of us must be willing to devote valuable time to the study of our public service, that we may take intelligent action in its direction and oversight.

As members of the leading industry of California we should, if united, be the controlling force in its politics. We should cease to be contemned as "fragments."

This annual convention of the Horticultural Commission is the only meeting in the State's calendar specially called in the interests of the fruit-grower. Would that there were more frequent opportunities for us to gather together and consult on the needs of the State of which we are so important a part, and in which we should be the prime factors in politics!

May I close by expressing a hope that this Hanford Convention will at least distinguish itself by uniting to demand from Congress the speedy inauguration of an up-to-date parcels post, and not only pass proper resolutions, but add their active efforts to those of our good friends, Prof. D. T. Fowler and John S. Dore, as working members of the Postal Progress League of California. May our success in this be so pronounced that we shall take courage to unite, to the end that in future we may become what we deserve to be—prime factors in California politics!

So mote it be. Amen.

MR. FOWLER. I desire to say a few words with reference to this important paper that you have heard read. I have thought of our friend who is the author of this paper and is not able to be here to-day. He was born in that little village across the ocean, London; but for many years he has lived in our State of California, and I am proud to say that I do not believe there is a more loyal American on this floor or in this State than Edward Berwick. I feel like saying that perhaps no more important paper, no more thoughtful one, has been delivered in this Convention.

I don't want to discuss the whole paper, but I do wish to discuss one part of the paper for a few moments, and then I wish to offer a resolution. At the Convention of the State fruit-growers held in Southern California some years ago, Mr. Berwick spoke upon the subject of a parcels post, and there was organized the Coast Postal Progress League of the State of California. He was made the first president, and has been continuously the president of that organization, and he has done much to further this matter. He is absent to-day, or I would not say what I am going to say. If he were here he would not have it said; but he has used, as some of us know, the most intelligent effort, and has put time and money into this matter, in advocating the principles of the parcels post and getting it introduced into the United States. He has placed it before the papers, even the metropolitan papers. He has discussed these questions with commercial bodies, and in some cases has met with great opposition. He has gone to Europe and studied the conditions there. I say all honor to Mr. Edward Berwick for what he has so intelligently, and so earnestly, and so ably done in the interests of the people of this State and of this nation, because the parcels post is a question that belongs not alone to the fruit-growers of California, but, as a great problem, it belongs to the people of the entire nation, and he has been a very great factor in awakening the people of this nation.

The President of the United States, as is said in this admirable article, and the Postmaster-General, have the power to make a convention with foreign governments in the matter of the introduction and the postage on the foreign post; but when it comes to the domestic post, then it must be done by Congress. And you gentlemen, every one of you, are responsible, because in this country the will of the people should control, and when the people rise and say they will, then they may have it.

So let us take it home to ourselves, you and I. It has been the great express companies that have kept this question behind for years and years. Every man who is an American citizen and who has studied the question knows this to be the truth—the interests of the express companies have prevented us from having a parcels post as good as Japan has, as Mexico has, and as most civilized countries of the world have.

Some figures have been given you in the paper. I want to give you just one. The English postal department can come here and say, "Will you carry our packages everywhere in the United States to the extent of eleven pounds?" And the express companies agreed with the English government, the postal department of England, that they would; and so all packages coming to the ports of New York and New Jersey are taken by the express companies and delivered wherever there is an express office all over the entire United States, and eleven pounds are sent for 24 cents through the express office.

I had eleven pounds sent to me, to make it exact, from Manchester, England. I live in Oakland, California. I live just outside of the dead line, because the express companies have certain ways and means by which there is an extra charge now and then put on above the expressage. Outside of that line, if I have a package delivered, it is 25 cents. I am a few blocks outside of the line, but inside the city of Oakland. But when the package came to me from Great Britain, when it came from the English postal department, the express messenger came up smilingly to my door and rang the bell and handed me the package and took a receipt for the same. If I had had it sent from San Francisco by Wells-Fargo Express, it would have cost me 25 cents, besides the expressage. If they can do this for the English postal department from New York to all places in this country for 24 cents, they can do it for 24 cents for an American citizen.

There is not time to discuss this question and show the inequalities that are in it. The other day, although it has not been widely published and the country press doesn't get hold of it somehow or other, the President made a convention with Peru. You know what the four-pound package is. It must be of such a size, and it is a very small package. But in this convention with Peru the package may be eleven pounds in weight, and it may be six feet long, and it can be six feet around or in diameter. But that is for a Peruvian. We don't ask in our parcels post what they ask. What is the size of a package there? It is limited to the size of a car door. What is it in Germany? You can send it fifteen hundred miles for 12 cents, and if one wanted a bill collected at the other end, the government will collect it and they will charge you the magnificent extortion, as commission for collecting, of 8 cents. Could you send your package of fruit to the extent of eleven pounds all over the United States and have the bill collected for 8 cents?

A bill passed the lower house of Congress to adopt this measure, but when it got into the Senate, the committee chairman there, Mr. Platt of New York, president of one of the great express companies, pigeon-holed it; and every time there has been something the people wanted upon this line, it has been pigeon-holed. Mr. Wanamaker answered that question thoroughly when he was asked, as Postmaster-General, the reason why this bill could not pass the Senate. He said there were four reasons: the American Express, the Adams Express, the Southern Express, and the Wells-Fargo Express.

Now, the State Fruit-Growers' Convention established the Postal Progress League and elected its officers. What is the percentage among us that are willing to pay their dollar to assist in this matter and to help in the matter of postage? The President of the League has put in over $200 of his own money, besides his time. Won't you pay a dollar and join the League? Now, here are the resolutions:

Resolutions Urging Congress to Pass a Parcels Post Law.

Resolved, That this California State Fruit-Growers' Convention, in its thirty-second annual session, assembled at Hanford, California, does hereby recommend our Senators and Representatives in Congress, urging them to use their most earnest and intelligent efforts to secure the passage of an efficient parcels post law, permitting the carriage of at least eleven-pound packages through the domestic post; and further

Resolved, That a copy of these resolutions be forwarded by the Secretary of this Convention to each of our Senators and Representatives in Congress; and further

Resolved, That a copy be sent to the Postmaster-General.

PRESIDENT COOPER. It is not necessary to suspend the rules the last day. The Committee on Resolutions has adjourned, and all resolutions have to come before the Convention. Is there a second to the resolution?

MR. DORE. I second it.

Question put and carried.

PRESIDENT COOPER. Professor Waite will now talk on "Peach Blight."

PEACH BLIGHT.

Address by PROF. M. B. WAITE, of Washington, D. C.

It is somewhat unnecessary to discuss the cause of the disease and the character of the fungus, inasmuch as I treated of this quite fully on Wednesday evening. I may say, however, that this little fungus was described several years ago in Europe, and named after a Swedish botanist. It has an outlandish Swedish name. It was named after the botanist Beyerink. Beyerink is a well-known botanist, but the peculiar spelling rather grates on American ears. The Latin generic name is *Coryneum beyerinkii.* It was discussed by Rev. M. J. Berkeley, the distinguished mycologist, as a disease of the peach, and he named it the gumming fungus. It has since been called by several different names. Pierce called it the winter blight, and the California growers, as a rule, call it peach blight. There are, unfortunately, several other peach blights in different parts of the country, so that that is not a distinctive name. However, if you add California peach blight to it you have got a name that would distinguish it anywhere in the world. It has increased very rapidly in this State, and has only recently been attracting general attention. It has, however, been known at the U. S. Department of Agriculture as a rather secondary disease of the peach in Ohio, and it has been sent to the department from Georgia.

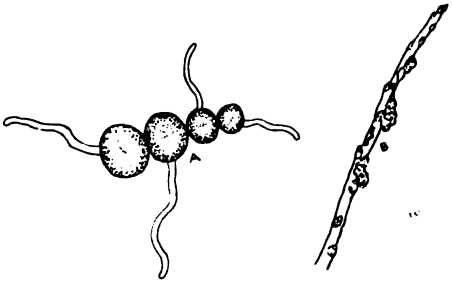


FIG. 1. Peach-Blight fungus. A. Manner of propagation. B. Peach twig showing characteristic exudation of gum.

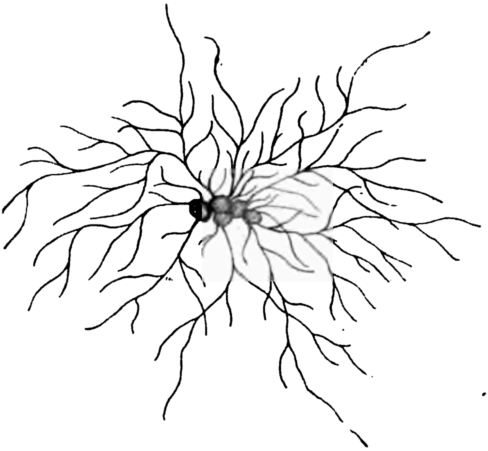


FIG. 2. Appearance of Peach-Blight fungus, artificially produced.

The little fungus which causes it is a very characteristic and pretty microscopic object. I made some rather hasty sketches to give you an idea of this fungus. The spore here is drawn from memory, and I would not vouch for its being accurate; it consists of several cells. (See Fig. 1.) It is not content to propagate by a single cell, so it has several joined together, varying from three to six. Each one of those spores has the power of germinating, and sends out a little sprout, which can sprout out at the time and enter the peach. They are smoky brown in color, and the germs are white. When this germ finds a suitable place to grow, in a drop of water or rain on the tree, it germinates; and this little fungus is sketched to give you an idea of what it is actually like. These little germ tubes are nothing but small, white, thread-like tubes, very minute and microscopic, altogether too minute to see unless you have a great many of them together—very much smaller than the threads of ordinary cotton or wool.

Figure 2 represents the condition which could be produced by growing a spore on nutrient jelly perhaps three or four days, and represents a somewhat similar condition to that which obtains when the fungus grows into the twig of the peach. These tiny threads pierce the cells of the bark, boring down into the wood in all directions, feeding on the material in the cells of the peach and killing the tissues as far as they reach. In other words, this little fungus is a parasite, which grows into the peach twig and kills those little spots. The result is a great many little brown spots form on the twigs. Many of these colonies of the fungus grow into the buds, and during the late winter or early spring the peach twigs are found to be peppered all over with numerous brown spots. Furthermore, many of the buds are either blackened and killed, or readily fall off on jarring, or are blown off by the wind; that is, the blossom buds especially. At certain rainy periods these little spots exude copious gum, which hangs down in strings or forms masses over the brown spots. The gum is produced by the peach tree itself, and is not limited in its cause to this particular fungus, as you all doubtless know. When the tissues are disturbed and partially killed, or perhaps I might say the live tissues in proximity to dead tissues, as in a wound, the stone fruits have a habit, instead of forming normal woody tissue, of forming a degenerate type of wood tissue—a degenerate type of cellulose of a gummy nature, and this gum is the result of these little wounds. It seems as though the peculiar irritation of this fungus of the peach does not instantly kill the cells, but slowly kills them, thus giving them a chance to react to an unusual degree to that tendency of gumming. Therefore, the gumming material is a conspicuous feature of this disease. Peach trees gum from mechanical wounds, punctures of insects, and from a great many other causes.

As to the destructive effects of this disease, I hardly need, perhaps, to go into details before this audience. In very many districts in California, not only in this district about Hanford, Visalia, and Fresno, but all the way up the great interior valley of this State clear to Shasta County, this disease has been remarkably destructive. The disease is probably more serious in the southern part than it is in the north, although in the moist region about the lower part there are some very bad cases. In fact, the large part of the peach orchards of the Sacramento and San Joaquin Valleys have been rendered almost commercially worthless, or commercially unproductive, during the last two or three years. Furthermore, the disease appears to be increasing, and the growing seriousness of this malady makes it positively alarming to the horticultural interests of the State.

One thing is certain, the fungus does most of its destructive work during the dormant or the semi-dormant season. It requires considerable moisture and rainfall to propagate and germinate. Like most other fungi of a parasitic nature, it requires distinct infection periods in which to gain entrance into a tree. The importance of infection periods is not ordinarily realized by the fruit-growers, but the investigating mycologist considers these periods of damp weather. These periods are not necessarily limited to rainfall, but cloudy and foggy weather, when drops of dew, in other words drops of water, may hang on the trees for a considerable length of time, give the spores time to germinate or sprout and enter the tissues of the peach twig before the sun comes out and dries them up. Doubtless millions and millions of spores are germinated in the night, and then burned up by the next day's sunshine; but when the conditions are just right, and the drops of dew or water can remain through the day, the spores germinate and the fungus enters the tree.

Since the disease has been studied, less than two years, the appearance has been mainly in January or early February. When I first saw the spots on the twigs about the 10th of February, it was evident that they were at least two weeks old. That would make the infection period, in 1905 at least, as early as the last week in January—probably as early as the 15th of January. Careful study will be required to determine whether that is the regular date for the appearance of the disease. This last spring the disease came about the same time, but the autumn was particularly dry, and it is not at all certain that the fungus had an opportunity to gain entrance last December. The fall was dry and cool. Of course, dry and cool weather will hinder the development of the disease on the peach tree, while rainy and warm weather will favor it. The importance of these infection periods, when it comes to the question of treatment, can hardly be overestimated. It is absolutely necessary, in case of spraying against fungi of this sort, to spray ahead of the germination of the spores and ahead of infection. In fact, it was the full understanding of this truth that led to the suggestion of spraying these peach trees in the early winter or late fall to make sure of getting ahead of the infection.

The first attempts at spraying with the Bordeaux mixture, and the repeated sprayings the California peach orchards have received with lime, sulphur, and salt, made commonly late in January or February, just before the buds swell, or just before the blossoms open, had no effect, or very little effect, on this disease, because infection had preceded. Unfortunately, the California fruit-grower has had more experience with the peculiar disease known as peach-leaf curl, which can be sprayed almost any time through the winter, but which is best sprayed just before the buds begin to swell. This treatment has misled them in attempting to apply the proper remedy for the gumming fungus, namely, fall or early winter treatment.

As to the history of the working out of the treatment for this disease, I may say that, fortunately for the California peach-growers, experiments were made last year, giving such positive and definite results that it leaves no question as to the reliability of the Bordeaux mixture treatment for this disease. The only questions which remain are those relating to the exact dates or the possible strength of the mixture. I will therefore give you briefly the experience on which our recommendations for treatment will be based.

On the William Pierce ranch, of which Mr. George Reed is superintendent, peaches were sprayed December 6, 1905, just about a year ago. The 15–20–100 mixture was used; that is, fifteen pounds of bluestone, twenty pounds of lime, and one hundred gallons of water. We think the strength is not especially important, but that is what was used. The peaches were not all sprayed on that date. It took several days to finish them—probably ten days. In the spring when the buds were swelling, about February 1st, or perhaps the last week in January, those varieties which had been most seriously affected were again sprayed with a 10–10–100 mixture. The question of whether single spraying or double spraying will answer has not been absolutely settled, but there can be hardly any doubt that a second spraying would be better where the disease is very bad.

Now, what was the result? When I saw these trees early in February, the wood and the buds were just as bright and sound as if no gumming fungus occurred in the vicinity. The spraying was thorough, and it was almost impossible to find a single spot of the gumming fungus on those trees. The trees bloomed out with the greatest of vigor and luxuriance and set a fine crop of fruit. Furthermore, although it was a rainy spring, they matured a splendid crop. Four hundred and two trees of Wager yielded one hundred tons of fruit. One hundred and eighty trees of Lovell yielded forty-two tons of fruit, and so on. Mr. Reed told me the Alexanders had not been as fine for several years as they were this year. People who didn't spray, lost most of their fruit. One orchard was pointed out to me the other day at Suisun where not a single box of peaches was picked and shipped from the orchard this year, which undoubtedly would have given a fair crop with proper spraying.

Mr. J. S. Brown, at Suisun, sprayed the last week in December, using 15–20–100 Bordeaux. Most of his peaches were Muir and Phillips Cling. He only sprayed once and got splendid results. It is possible that his trees had been less seriously affected the year before than those of Mr. Reed.

Mr. J. R. Chadbourne sprayed once early in January. That is still a little later. He got splendid results from a single treatment.

Under Mr. Reed's direction, Mr. J. R. Davidson started spraying early in January, and sprayed part of his peaches early in the month, but through rains, or delays from other causes, a portion of the orchard was sprayed late in January, and, as it proved on examining the peach twigs in February, too late, showing that last season, at least, early January spraying gave good results, but late January spraying was partially a failure.

As I said before, these dates are not considered absolutely safe for future guidance. Inasmuch as the peach buds are already formed, and inasmuch as the Bordeaux mixture is persistent and sticks on the twigs for a long time, it would be safer to begin the treatment early in the winter or fall. We therefore recommend, as the best knowledge we have at the present time, to have the spraying done during the last half of November, and we consider December 1st a date at which most of the spraying should be finished. It is quite possible that from December 1st to 15th may be all right, and we have no reason to believe that up to the present time it is too late to spray peaches in this vicinity. However, we feel that you are beginning to run the risk if you delay later than this.

Undoubtedly, in badly infected orchards at least, perhaps on all orchards, the trees should be sprayed again about January 15th, or perhaps from January 15th to February 1st, according to the date when the buds begin to swell. When the buds begin to swell, give the trees a second treatment. Further tests are being made to determine the safe treatment.

We need further tests as to the strength of the mixture. There is very little doubt in my mind that the standard strength of six pounds of bluestone to four or six pounds of lime will be all that is necessary; and in the Eastern states, in fighting the bitter rot of the apple, the most serious disease in that country, they use the 5–5–50 Bordeaux, or 10–10–100 according to the California way of mixing it. This has given good results.

Now, as to the theory of copper spraying. I wish I had made one more diagram to show that, but we will talk of this supposed peach twig. If you spray this twig in the fall of the year with Bordeaux mixture, there are little spots of the copper sulphate and lime compound dotted all along down the twig, films of it running over the tissues, and portions of the copper wedged into the crevices of the bud. Now then, when the rain comes, this Bordeaux mixture does not wash off like bluestone solution, but it very slowly dissolves. We call it an insoluble compound. As a matter of fact, it is a difficultly soluble compound, or slowly soluble compound, and minute traces of the copper material are dissolved by the water.

Copper is a very peculiar poison, and very peculiar in its poisonous effects on plant life. While it is very slightly poisonous to man and animals, minute traces of copper, in some places one part to fifty millions of water, are able to kill plant life. I don't know just the susceptibility of the germ tubes of this *coryneum*, but they must be susceptible; in fact, they are extremely susceptible to this Bordeaux mixture. The result is, by having the Bordeaux there first, when the rain falls that makes the infection periods, those same drops of water carry minute quantities of this copper solution, and the fungus can not germinate, and is killed. Spores sprout out and are killed, and, having lost their power of germination, are harmless.

Now, I have been asked what is the function of lime in the bluestone solution. While the copper is the true poison and possesses the toxic properties, lime is absolutely necessary as the vehicle by which it is sprayed on the tree and maintained in this slowly soluble condition by which it is always ready to do its work when the drops of water come on. I saw the other day at Suisun some of these sprayed peach trees with quite a decided blue coating on the wood from three to four years down to where the copper was sprayed on a year ago, or nearly a year ago, showing the wonderful persistence of this mixture.

Now, one of the important questions that you are going to have is how to get good Bordeaux, how to avoid bad Bordeaux. Unfortunately, much of the Bordeaux mixture that is made is bad. Much of the spraying is poorly done, and the fruit-grower is frequently, through lack of knowledge in regard to methods, and lack of experience in doing the best possible work, kept from getting the best results. So we will go into detail a little.

First, as to the composition of the Bordeaux mixture. It sounds like a very simple thing to put a little bluestone solution and a little lime together in water, but the Bordeaux mixture is wonderfully complicated —in fact, is so complicated that up to the present time the analytical chemists have not been able to tell us all the changes that take place in this mixture. No chemist can to-day write the formula for Bordeaux mixture. It will be impossible to go into all the details, because that would take all the morning, but I can give you a few ideas to show you how complicated this mixture is. I regret this can not be discussed without using the chemical terms.

Now, the ordinary milk of lime is calcium hydroxid. Of course lime is not pure. It is always air-slaked and carbonated to some extent. So the lime consists of calcium hydroxid, or caustic lime. It is a saturated solution with particles of the caustic lime in suspension. Furthermore, it has its principal impurity in the form of carbonate of lime, which is only slightly soluble in water. In fact, the caustic lime, when it changes to carbonate, crystallizes in the form of a scum over the solution.

The bluestone solution is a much more simple mixture, consisting of copper sulphate; that is, sulphuric acid and copper. Both of these materials may have impurities in them which possibly at times are important, and which we will not go into now. When you pour those materials together a curious reaction sets up. The hydroxid of lime has a greater affinity for the copper than the sulphuric acid has, or vice versa, the sulphuric acid takes part of the lime and therefore frees the copper, which combines with the calcium hydroxid; but this is not a simple reaction, for we have formed not only calcium sulphate, that is, sulphuric acid, from the bluestone combined with the lime, but we have calcium copper hydroxid, part of the calcium staying with the hydroxid and taking the copper along with it. That goes down as a blue precipitate; that is, blue slushy material that is carried down. This, however, is not pure, because during the reaction it carries down grains of calcium hydroxid which do not enter into the reaction. In other words, part of the lime goes down into the slush as pure lime, and the carbonate of lime also goes down.

So, you see, that is a wonderfully complicated thing. Furthermore, there is some basic copper hydroxid in the precipitate in which the reaction is not fully satisfied. A still more remarkable thing occurs during this precipitation; namely, that even though you may have an excess of lime, which is always the rule in this mixture, it is impossible to precipitate all the copper sulphate out of the solution. Therefore, in spite of the fact that an excess of lime is used, some of the bluestone always remains in solution.

There are several other interesting phases of the matter which give to the Bordeaux mixture its real value. I refer to the residual products. Having an excess of lime there is residuum always in the clear solution, the saturated solution of lime. When the sulphuric acid leaves the copper and goes to the lime, it forms sulphate of lime, which is gypsum or land plaster. Part of that precipitates, but it is a very soluble material, so we also have a saturated solution of gypsum. These two solutions of gypsum and lime play an important part in the Bordeaux mixture—so much so that it is impossible to drain off the clear solution and again moisten the granular matter with water after keeping it some time, and have the same mixture. You can not make the Bordeaux mixture, evaporate it to dryness, and then wet it with water again and use it. You have got to have all the materials as they come together. The reason for that is that this saturated solution of gypsum and lime acts as cementing material when the spray dries on the twig. The lime in the form of hydroxid, when it is sprayed on the twigs, turns to carbonate, and it is just like the setting of mortar or plaster. You set this material on there and you not only have the advantage of the copper mixture, but you have the cementing material that sticks it on the twig. Furthermore, that cementing material is not absolutely insoluble, does not lock the copper up entirely, but slowly lets it dissolve.

So, you can begin to see what a complicated thing we have in this mixture. It is twenty-one years since the Bordeaux mixture came into prominence. It was discovered by Millardet of France. Efforts have been made to get other copper compounds which would be cheaper, which could be sold in packages and diluted, but nothing has ever met the requirements as this particular preparation has. There are certain places where the other mixtures can be used to advantage, but as an all-around fungicide, Bordeaux mixture, on account of this complicated thing, the cementing material, and the slow solubility, has proved of most value.

I have given you the composition of Bordeaux mixture as it is thrown on the trees; but the complication does not end there by any means, for just as soon as the material begins to dry on the trees, other changes take place. Bordeaux mixture is almost like a living thing—it keeps going on. The excess of hydroxid begins to carbonate. It takes several days to do it; but the peach leaf, like the violet leaf, will stand the Bordeaux mixture till the caustic lime begins to carbonate; and then at the same time this compound, hydroxid of lime and copper, begins to break down, part of it being converted into carbonate. Copper carbonate is slightly soluble in water; still more so in rain water or ammonia water. Many plants are injured by rainfall after they have been sprayed two or three weeks with Bordeaux mixture. In the Eastern states, where there are summer rains, we are having great difficulty now in trying to spray our peaches with Bordeaux mixture. We tried to avoid it by using peach Bordeaux mixture of three pounds of bluestone, nine pounds of lime, and fifty gallons of water—an enormous excess of the lime, so that the caustic lime will remain there the greatest possible time. Furthermore, the difficulty can be partially avoided by repeating the spraying, or even by spraying with the lime water alone.

It is a little too complicated to carry in one's mind, and I may not have given you all the important facts, but I have the most of them. At any rate, one should be very humble when he preaches Bordeaux mixture, and accept very positive dictation on the part of the investigators as to how to make it.

As to the practice of making up this mixture in the orchard, there are several schemes that will be helpful, and while you may not all want to do exactly as I tell you, so far as the arrangements are concerned, I will give you an ideal plant, one that I devised myself several years ago, and which has worked beautifully. This scheme combines all the best known methods of making up the Bordeaux. In the first place, the copper sulphate solution can be made up in stock solution, instead of weighing out the bluestone every time you want to make up a batch. Referring to the figure, this little barrel on the back part of the platform represents this stock solution barrel of copper sulphate. (See Fig. 3.) By suspending fifty pounds of bluestone on top of the fifty-gallon barrel, and filling the barrel with water, you can, in twenty-four hours or so, oftentimes less, dissolve the bluestone. After it is dissolved, fill the barrel to the fifty-gallon mark and stir a little, and every time you take out a gallon you have a pound of bluestone. There is some difficulty in keeping this over long periods, but during a reasonable time this can be kept on hand. By having two or three barrels, or perhaps more, a large spraying outfit can be equipped with a continuous supply ready to be drawn off by the gallon. Any of you who, in the early days, spent valuable time while the trees were waiting, and dissolved bluestone without hot water, can appreciate the importance of this.

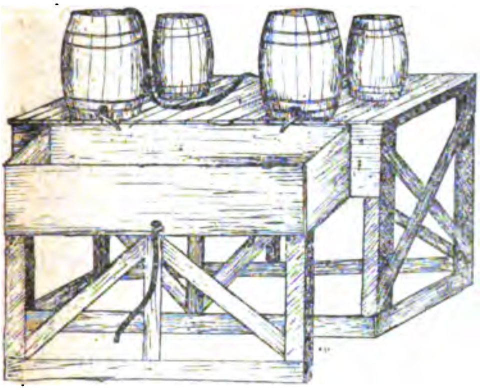


FIG. 3. Apparatus for making Bordeaux mixture.

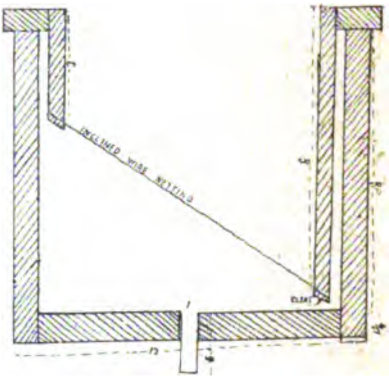


FIG. 4. Details of strainer for filtering Bordeaux mixture.

Lime can also be kept in solution, a pound to the gallon, or two pounds to the gallon.

Assuming, for all purposes, that we wish to make up a hundred gallons of the mixture, enough to fill a hundred-gallon spray tank. To get the best results one should have an elevated platform above the height of the spray wagon. Have your stock solution of copper on one side and your stock solution of lime on the other. If you have a side hill, it is very convenient to build this so that you can drive on the lower side with the wagon. I hardly need to say, perhaps, that it is necessary to have this at a water supply, where either with a pipe or hose you can run the water rapidly into these tanks.

We call these two large tanks on the front of the platform dilution tanks. It is necessary, to make good Bordeaux mixture, to dilute the material with the greatest possible amount of water, and then run the two solutions together simultaneously. It is a wise plan to strain all this water, unless you have a very pure water supply, through copper wire with meshes about sixteen or twenty to the inch. Especially will it be necessary to strain the lime. This can be fixed up while the spray tank is in the orchard, or it can be fixed up the day before. It is desirable, before running them together, to stir the lime thoroughly. It is advisable to make the Bordeaux mixture just as you are going to use it. Use it all up the same day, if possible. It is better when it is freshly made up. (See Fig. 4.)

In all this preparation, avoid the use of iron in contact with the copper. The vessels should be made of wood, with copper or wooden fittings. The copper is precipitated by iron. Particularly avoid the use of iron in contact with the bluestone solution before it is combined with the lime. You can, in an emergency, use iron in contact with the made-up mixture, although it gradually reacts on the mixture, having a very slight effect on the mixture where it is used rapidly. Where an iron spray tank is to be used, it should be coated with asphalt or something of that sort to prolong its life.

Now, when it comes to work in the orchard, I must not forget the very important matter of spray outfits and nozzles. As a rule, I think you need no suggestion from me as to the pumps and spray machines. California leads the world in power spray outfits. Nozzles need my suggestions. Bordeaux mixture spraying requires a finer spray and a thinner coating than the lime-sulphur-salt spraying with which the California orchardist is most familiar. It is better to use the Vermorel type of nozzle, one that gives a mist-like spray, so that you can not help coating every portion of the twig, or at least thoroughly peppering the spots. Many of your orchard trees are too high to spray from the ground. It will be a great advantage if you will fix an elevated platform on top of your spray tanks. It is so much easier to hold the nozzle on the sides of the tree than it is to go up on top, that many men will always spray the bottom of the tree first, and they spray about four times as much material on the bottom as they do on the top. In this peach fungus, it is important to reverse that, and spray the top first. Then there will be little to do on the bottom.

RESOLUTION OF THANKS.

MR. JUDD. I have a resolution to offer:

WHEREAS, The fruit-growers of California in their thirty-second Convention held at Hanford, deeply appreciate the welcome which has been extended to them; therefore, be it

Resolved, That this Convention give a vote of thanks to the Committee of Arrangements, which has taken such pains to make our Convention a success; to the Committee on Excursions, to whom we owe a pleasant outing, and to the other committees which have aided in the work.

Resolved, That we extend a vote of thanks to the ladies of the Reception, Entertainment, and Banquet committees for their splendid entertainment and the cordial welcome extended to us.

Resolved, That we extend our thanks to Mr. H. A. Beekhuis and the Town Council of Hanford and to the Supervisors of Kings County for their liberal assistance.

Resolved, That we vote our thanks to the press for its full and faithful reports of our meetings, and for its earnest labor in our behalf; and finally, as we can not enumerate all who have made our stay a pleasure, and our convention a success, be it further

Resolved, That we extend a vote of thanks to the people of Hanford as a whole for the generous reception we have met with, and that we shall ever remember the Thirty-second Fruit-Growers' Convention held at Hanford.

MR. DORE. I move the adoption of the resolution.

Motion seconded, and carried unanimously.

RESOLUTION OF THANKS TO THE PRESIDENT AND SECRETARY OF THE STATE HORTICULTURAL COMMISSION.

MR. JUDD. Here is another resolution:

WHEREAS, The fruit-growers of California have learned to appreciate the untiring efforts of our very worthy President, Ellwood Cooper, and our very efficient Secretary of the State Horticultural Commission, John Isaac; and

WHEREAS, Through their untiring efforts the Fruit-Growers' Convention have become a power of great good to the many industries represented; therefore, be it

Resolved, That this Convention tender them a vote of thanks, and to further show our deep appreciation we hereby express a hope that we will continue to have their invaluable services.

MR. DORE. I move the adoption of the resolution.

The motion was put by Mr. Judd, and carried unanimously.

JOHNSON-GRASS, AND OTHER NOXIOUS WEEDS.

MR. D. H. GRAY. We have listened to pear blight and we have listened to peach blight; we have listened to several diseases of fruit; but nothing has been said with regard to many diseases which are spreading throughout the State. I will refer to Johnson-grass. This is a very noxious weed. It is a weed which has spread throughout the country by means of irrigation, sheep, cattle, and stock generally. It has cost many thousands of dollars to those who have gotten rid of it on their farms. When I was a little fellow I remember my father employing twenty-five or thirty Japs to get rid of this weed, for which a few years before he had paid a dollar a sack. These men dug there for about a year. Our place is now practically free from it. Bermuda is almost as bad, and there are a great many vineyards that have become utterly worthless on account of it. This state of affairs, it seems to me, demands the attention of this body, and I think that some resolutions should be brought before this body, and that we should have the support of the supervisors of the different counties and have State laws which should be enforced. Therefore, I have a resolution here which I will submit.

WHEREAS, The principal fruit-producing parts of California have become infested with Johnson-grass and other noxious weeds; and

WHEREAS, Such weeds and grass have obtained such a hold upon the country that if something is not done to exterminate them within a short time, utter ruin to our orchards and vineyards will be the result; therefore, be it

Resolved, That it is the sense of this meeting that the laws relating to infectious weeds be revised and strictly enforced; be it further

Resolved, That the supervisors of the several counties take this matter up and aid the fruit-growers in saving this country from the grip of Johnson-grass and other such infectious weeds.

MR. DORE. I move the adoption of the resolution.

Motion seconded, and carried.

(At this time a recess was taken until 1:30 o'clock P. M.)

AFTERNOON SESSION—FOURTH DAY.

FRIDAY, December 7, 1906.

The Convention was called to order at 1:30 P. M., President Cooper in the chair.

PRESIDENT COOPER. The first paper this afternoon is "Methods of Increasing the Bearing of Muscat Vines," by Prof. Frederic T. Bioletti.

METHODS OF INCREASING THE BEARING OF MUSCAT VINES.

BY PROF. F. T. BIOLETTI, OF BERKELEY.

The statistics of the raisin industry of California which I have been able to obtain are somewhat indefinite. A comparison of the various estimates indicates, however, that there are approximately 70,000 acres of vineyards devoted to raisin grapes and that the average crop during the last ten years has been about 45,000 tons, or 1.56 tons of dried grapes per acre per year. The variations between different years are considerable, and the variations between different vineyards even greater. Some of these variations are due to weather conditions and differences of soil which are beyond our control. Others, however, can be controlled with more or less certainty. The object of this paper is to show some of the ways in which some unfavorable conditions can be removed and the crop increased at present, and to suggest some methods which promise further improvements for the future.

The principal causes of deficient crops are the following:

1. Unfavorable weather. Spring frosts, cold or wet weather during blossoming, excessive heat during ripening, rain during the drying season.
2. Vine diseases. Oidium, coulure, vine-hoppers.
3. Improper cultural methods. Lack of cultivation, rise of water level, bad pruning.
4. Impoverishment of the soil. Lack of phosphates, humus, lime, rise of alkali.

I will not attempt to cover the whole of this ground, but will simply make some suggestions regarding proper methods of pruning and of the control of the diseases, oidium or mildew, and coulure or dropping of the grapes.

Diseases.—Oidium, or mildew of the vine, is a disease to which many grape-growers of the San Joaquin Valley have given no attention. While it never does such complete damage here as in many districts, it is often a serious factor in diminishing or deteriorating the crop. It is one, however, which is completely under the control of the grower and, in most parts of California, at comparatively small cost.

If the grower in the San Joaquin Valley will sulphur his vines properly at the right time he will have no injury from mildew whatever. One sulphuring during blossoming time might in normal seasons be sufficient if everybody sulphured every year. As it is, a wiser plan is to sulphur once during the first warm weather of spring when the vine shoots are six to eight inches long, and a second time when the vines are in full bloom. After blossoming it will seldom be necessary to sulphur Muscats at all, except in exceptionally moist locations or seasons.

The method of throwing on the sulphur by hand or with perforated cans should be abandoned. It is wasteful of time and material and does not do the work effectively. Some efficient form of dust sprayer should be used. Unfortunately, no efficient hand machine seems to be made in the United States suitable for this purpose. Several are made in Europe, however, and they will more than repay the cost of importation the first year they are used, in saving sulphur alone. This was well shown by tests made by the Experiment Station this year. The estimates in the following table are based on these tests.

Amount of Sulphur Used Per Acre.

	1st.	2d.	3d.	Total	Cost of Sulphur.
Best Dust Sprayer.....	5 lbs.	7½ lbs.	10 lbs.	22½ lbs., at $2.50	$0.56
Can Shaker............	7 lbs.	30 lbs.	50 lbs.	87 lbs., at 2.00	1.74
Hand.................	12 lbs.	40 lbs.	75 lbs.	127 lbs., at 2.00	3.54

Sublimed sulphur of good quality should be used with the dust sprayer for the best results, while a cheaper form is almost equally good for the other methods, as much more is used if the vine is properly treated, and, unless the sulphur is of very bad quality there will be enough fine material in the amounts indicated to do effective work. Even though we use cheap sulphur with the usual methods, the total cost of material for three sulphurings will be about $12 for the shaker and $30 for hand sowing more than for the dust sprayer on every ten acres.

This does not show the whole gain, however. If the sulphuring is done thoroughly enough to be effective there is a gain in time and labor with the dust sprayer. The principal gain, however, is in the better work done. The machine sulphuring would be preferable even though it cost twice as much, as the control of the mildew is made much more certain.

A small quantity is just as effective as a large, providing some sulphur reaches every part of the canes and leaves of the vine. If we can see the sulphur on the vine from a distance of twenty feet, too much has been used. If, on close inspection, we can not find particles of sulphur on every part of every leaf the sulphur has not been properly distributed. It is impossible to avoid both of these defects except by the use of an effective machine distributing the sulphur by means of a strong current of air.

Coulure—The raisin Muscat is particularly subject to a disease or accident which is commonly known as "coulure." This consists of two forms: the dropping of the blossoms without setting, which we call *early coulure,* and the dropping of the berries when they are small, which we call *late coulure.* The early form is the most usual and serious in the case of Muscat.

Many theories as to the cause of this trouble have been advanced, but it is only lately, through the researches of Messrs. Viala and Pacottet, that the real origin of the coulure of the Muscat has been discovered.

This discovery has made it possible to increase the crops of this grape in the graperies of Paris more than tenfold. The means used are inapplicable to large vineyards in the open air, but a knowledge of the facts brought to light by these investigators may enable us to devise methods of control suitable to our conditions. The cause of the dropping lies in the peculiar structure of the flower itself.

The flowers of most cultivated varieties of grapes are what the botanists call "perfect"; that is, each flower has the two elements which are necessary for the development of the perfect fruit. These elements are the pollen contained in the anthers and the ovules contained in the pistil. Unless the ovules are fertilized by normal pollen the pistil will not develop into a normal grape berry.

There are several defects in the Muscat flower which make this necessary pollination more uncertain than with most varieties, and it is only under the most favorable conditions that the ovules are properly fertilized.

In the first place, owing to the shortness of the filaments supporting the anthers, the position of the pollen is such that it may all fall off without reaching the stigma, which is the part of the pistil through which the pollen tube obtains access to the ovule.

In the second place, the pollen is not powdery as with most vines, but waxy and with a tendency to cohere in masses. This renders its distribution by wind and insects much less certain. The pollen grains are, moreover, often imperfect and most of them are incapable of germinating and performing their function, even if they reach the stigma.

The means which have been adopted in the Paris graperies for overcoming coulure is the artificial pollination of the blossoms with the pollen of staminate vines. Certain American vines used as phylloxera-resistant stock are sterile, because they have imperfect pistils. Such varieties, on the other hand, have very abundant and vigorous pollen, which, owing to its dry, powdery nature, is easily collected and distributed. The variety chosen is the Aramon Rupestris No. 1. The Rupestris St. George, which is also a sterile vine, could be used for the same purpose.

The pollen is collected and if necessary kept until needed between sheets of dry blotting paper. During the week or ten days during which the Muscat is blossoming the pollen is blown on to the bunches three times a day by means of small bellows. The result is that graperies which formerly produced only from 25 to 75 pounds of grapes to each 200 square yards, now produce from 900 to 1,100 pounds in the same space. The Muscat bunches, moreover, which were formerly loose and straggling, are now so compact that it is necessary to thin them.

It was found that this artificial pollination, in order to be effective, must be performed when the temperature is favorable; that is, about 77° F.

Another necessary condition was found to be a dry atmosphere. If the air or even the soil was moist, a drop of liquid formed on the end of the style. Two or three drops would form and fall during the day and carry off all the pollen which had settled before the pistil had been fertilized. When the moisture in the air did not exceed fifty per cent the fertilization took place satisfactorily.

This method, while effective and profitable in a hothouse, is of course inapplicable to vineyard conditions. It offers us some suggestions, however, which may be useful.

We would do well to follow the practice, which is common in the raisin districts of Spain, of planting a certain proportion of varieties with strong pollen in connection with all Muscat vineyards. These varieties should be planted in such a way as to facilitate cross-pollination as much as possible. It is impracticable to mix the varieties thoroughly, but it would probably be sufficient if every tenth row, for example, were of another variety. The pollinating varieties must blossom at the same time as the Muscat and must have strong pollen, as evidenced by the regular setting of their grapes. I would suggest the Palomino, a heavy-bearing sherry grape of good quality, or the Perruno, useful for the same purpose and also a first-class white shipping grape. The Malaga also might be used, but I have no data as to its time of blossoming.

The moisture and temperature conditions are difficult to modify, but something can be done even here which may help. The mean temperature for the month of April at Fresno for a term of twelve years has been 60.8° F., varying from 54.7° F. to 67.1° F. The temperature during the last two weeks, when blossoming usually takes place, will be slightly higher than this, which indicates a day temperature which is sufficient for the proper setting of the grapes. The average moisture for the same period in April has been 58°, or somewhat less than this for the last two weeks, which is also favorable.

The later the vines blossom, therefore, the more likely they are to set well, as the weather will be warmer. Little can be done to delay the blossoming. Some slight effect might be obtained by spraying the vines with whitewash before they bud out.

We can control the moisture condition to some extent by avoiding cultivation during and just before blossoming. The air is moister near the soil than a few feet above, so that vines with a head two or three feet from the ground should set their fruit better than those flat on the ground. High vines also blossom a little later than low ones.

Probably some improvement in the setting of the fruit could be obtained by a careful selection of cuttings. The Huasco grape, which was imported from Chile and has been growing for many years at the Tulare Experiment Station, differs in nothing from our Muscat, except that it sets its fruit a little better. By selecting cuttings from vines which set their fruit well, and especially from those which blossom a little later than the average, we might modify some of the defects of the variety.

Pruning.—With many varieties it is possible to regulate the number of bunches which a vine will bear by the method of pruning adopted. If we cut off everything but the watersprouts or canes coming from old wood, we remove nearly all the buds which are capable of producing blossoms and, therefore, prevent all possibility of a good crop. If, on the other hand, we are careful to leave only fruit spurs or canes coming from wood of the previous year's growth, we give the vine the opportunity to produce a large number of blossoms and, therefore, if all other conditions are favorable, a large crop.

With the Muscat the bearing is less easily regulated by this means, as, usually, all canes have fruit buds and we will obtain blossoms even though we leave nothing but watersprouts.

It is for this cause, probably, that Muscat vines are more carelessly pruned than any others. With this variety the results of bad pruning do not always show the first year in diminished crops. A great deal, however, can be done in improving the health, vigor and, consequently, the bearing, even of Muscat vineyards, by intelligent and careful pruning.

If we examine a vine in many old Muscat vineyards in winter we will find that it consists of a gnarled stump rising six or eight inches above the soil, with a diameter of from twelve to eighteen inches. On this shapeless mass of wood will be found from eight to twenty spurs, usually around the edge or coming from below the ground, while in the center will often be found an abundant growth of toadstools, showing that a great part of what is called a vine consists of dead and decaying wood. Such a vine can not produce regular and abundant crops.

While spring frosts are to some extent responsible for this peculiar condition, the main cause is lack of care and system in the pruning, The proof is that some vineyards, more carefully handled, have vines of normal shape.

A Muscat vine, like any other, should have a distinct stem or trunk. This trunk should be smooth and without spurs or scars. This trunk makes it possible to plow, cultivate, and hoe close to the vine without injuring the arms or spurs. It facilitates the removal of suckers from below the ground and holds the bearing wood high enough up to keep the grapes from touching the ground. How high this trunk should be will depend on various conditions. A smooth stem twelve inches in length from the surface of the ground to the branching of the arms is sufficient to give the advantage mentioned. The only reason, in the case of the Muscat, of having a longer stem is the slight protection it gives from spring frosts. The nearer the shoots are to the ground the more liable they are to injury by freezing. It is perhaps not practicable to raise the vine much higher than indicated, however, on account of the shading of the drying trays which would result. Sultanina grapes, however, are dried in vineyards where the vines are trained up four feet or more.

At the top of the trunk four or more arms should branch out symmetrically. The more even and symmetric the vine the better the grapes will be distributed and the more evenly and perfectly they will ripen. The pruning, control of mildew, and all cultural operations will also be much facilitated.

Another great advantage of this form is that it is less subject to injury, and any injury it does receive is less likely to permanently affect it. If an arm is broken off by accident the wound can be sawn off smoothly and painted. Even if this is not done, it is much less likely to decay, as the position of the wound high up in the dry air makes it less susceptible to the attack of wood-rot fungi, which quickly enter wounds surrounded by moist air near the ground.

Muscat vines pruned high and kept vigorous are more likely to set their fruit better, because they will blossom a little later and the air will be less moist.

Some of the most serious causes of deficient crops in certain Muscat vineyards have not been considered in this paper. Much improvement would result if we could control the rise of alkali and seepage water. This, however, is too big a subject to be properly treated on the present occasion, and the methods to be adopted are still uncertain, or only in the experimental stage.

The ravages of the vine-hopper are responsible for serious injuries to the quality and quantity of our crops and demand thorough investigation. The Agricultural Experiment Station is planning a series of tests looking toward the control of this pest. These tests will be commenced and carried out as completely as our resources will allow during the coming season.

The fertilization of nearly all our vineyards will sooner or later be necessary, and many of them are in urgent need of it at present. This is a subject which we are now investigating, and we hope before long to be able to give some definite recommendations in this respect. Most Muscat vineyards would undoubtedly be benefited by applications of complete fertilizers, and especially of phosphatic and nitrogenous manures. The main subjects for investigation are the relative cost of the various obtainable forms and the amounts of each which it will be profitable to apply.

In conclusion, while waiting for results in those lines which demand further study, much improvement can be obtained by more careful pruning and complete control of the mildew, and, where new vineyards are started, avoiding the planting of large areas of Muscat vines without a mixture of varieties producing good pollen.

(At this time, two hundred high school pupils came into the Convention hall.)

PRESIDENT COOPER. The chairman of the school board of Hanford made a request that the pupils of the high school come in and spend a short time with us. Of course we have a very extended program, but I will say a few words to the pupils.

Seventy-three years ago, when I first entered the primary schools, there was no public school system in the State of Pennsylvania. I attended a private school in Chester Valley. It was an eight-sided school, known as an eight-square school, but most generally known as the "hornet's nest." So I commenced my life at a very early age in the "hornet's nest." Whether the hornets had anything to do with the activity of my life I am unable to say. After one or two years of life in the "hornet's nest" my father moved to Bart Township, Lancaster County, Pennsylvania. The section was very sparsely populated, and private schools were very far between. However, I was in attendance in these private schools down to the time Pennsylvania established the public school system in the rural districts, which, in the beginning, was very crude and different from what it is at the present time. I have a distinct recollection of attending school with young men all the way from twenty to thirty years old who were learning to read. So, you can see the great advantages which you have over what we had when we were little children.

The Governor told us the other day that half the revenue that entered the State treasury was expended for the public schools, so you can realize the advantages which you have in getting an early and efficient education for the duties of this life.

The public school system at that time, as I said before, was very crude and the school houses were very great distances apart. Some of them were five miles apart, so that some children had to walk two miles and a half to school, carrying their lunches with them, and two miles and a half back at night. The people at that time thought that the number of hours a day spent in the school room must necessarily be long. They were required to be there at seven o'clock in the morning, and remain there, in the short days, until dark.

Now, students, you realize the great advantages you have at the present time over what we had seventy years ago; and it is necessary for you to realize and to understand that very soon we will pass away and you will take our places in the civilization and the government of this great country. I hope that the advantages you have over what we had will give you great advantages over our life and activity.

The greater the amount of energy and determination and desire that you have to do something, to be something, the happier will be your lives.

Of course, if I had time and the circumstances would permit, it would give me great pleasure to go back and give you a history of the conditions that I passed through in my early boyhood, but we have not the time and I am not prepared, so I hope and wish the best results for you. I am very much gratified that the chairman of the school board has brought you here in order that I may see you. The happiest moments of my life have been with the pupils and I must say that I am very happy to see that the sexes are about evenly divided—about as many boys as girls. All the schools I ever attended were mixed schools, and it gives me great pleasure to see you and to know that you have the interest to come here. (Applause.)

MR. W. R. McINTOSH. I am exceedingly glad the children came here this afternoon, which rejoices me more than anything else in the part I shall take in this Convention. The topic I shall present concerns your lives this moment, more, perhaps, the agricultural and horticultural interests of your State and county than anything else. I refer to the lives of the wild birds. The result of no education at all along the lines of care and attention to wild birds in their nests during the breeding season is one of the lamentable things in the life of our nation to-day.

I want to say that perhaps you may know something of the societies which are being organized, known as the Audubon societies. Your speaker is a member of the State society organized in Los Angeles last April. There is a society in Fresno County, in your immediate neighborhood. This society in Fresno was organized twelve months ago, and has done considerable work. We demonstrated the value and importance of taking up this work in last May, when we had what we called our "Bird Day." I hope the time will soon come when every town and village in California will have not only its adult societies known as the Audubon Society, but the juvenile society in connection with it.

THE ECONOMIC VALUE OF WILD BIRDS.

By W. R. McINTOSH, of Fresno.

Nowhere in the material universe do we find a more interesting and beautiful law of balance and harmony than formerly existed in the lives of insects and wild birds. Insects are justly regarded everywhere as the enemies of agriculture. Their destroyers—the birds—must, therefore, be the farmers' best friends. So long as nature held undisputed sway our friends kept our enemies in check and small damage resulted to growing crops, and the husbandman was fairly secure in his calling.

In the destruction of the home of wild birds—the forests—by ax and fire, and the wanton and cruel slaughter of birds, in the name of sport, the relations and harmony of nature have been undermined and the balance destroyed.

Wild birds are decreasing to an alarming degree in every part of the United States. Injurious insects, as might have been expected, are, therefore, on the increase in a similar ratio. So striking has been the increase of insect depredations on fruit trees and growing crops of late years that the appeal of farmers everywhere for relief is constantly on the increase. Scientists are searching every part of the known world for insect-destroying parasites, while millions of dollars are being spent yearly in a vain attempt to check the ever-increasing ravages of these enemies of agriculture, horticulture, viticulture, and gardening.

The menace to successful agriculture is not comprised in insect pests only. The rodents and noxious weeds must engage the constant attention of the farmer. Here, again, the feathered friends of the farmer find ample scope for usefulness to mankind. The hawks, owls, shrikes, and eagles live almost altogether upon the rodent enemies of the farmer, while the seed-eating birds—the sparrows, finches, buntings, and grosbeaks—comprise more than one seventh of the North American species of birds.

And, while there has been much wanton destruction of birds and almost universal indifference as to their existence, the birds have not been without their friends.

Since the birds first gladdened the earth with their morning song and the beauty of their plumage, there have always been those who loved them, and who have done all they could to protect and care for them. But in this busy, hurrying world of ours, where the dollar has assumed such abnormal importance, we must be able to give an economic reason for their protection as well as an æsthetic one.

Mr. Scott Way, secretary of the California Audubon Society, said recently: "When the first efforts to organize an Audubon society in this State were made, I was told that the farmers were unfriendly to the birds, and that they would oppose bird protective legislation. I did not believe it, because there is no more intelligent farming class anywhere in the world than we have in California, and every intelligent farmer knows, if he has given the subject the least investigation, that without the birds the insect hordes would soon devour every cultivated crop, and that in a very few years human life would become impossible upon the earth. There was very soon ample evidence of the friendliness of the California farmers toward the birds in the way of resolutions of approval and letters of encouragement from farmers' organizations in every part of the State, and many of these gave noble and valued support to the efforts of the Audubon society for the protection of non-game birds."

Data gathered by the United States Department of Agriculture show that the annual tax paid to insect depredations exceeds the annual expenditure of the National Government, including the pension roll and the maintenance of the army and navy.

In one year a single species of insect, the chinch-bug, caused a loss of $60,000,000, and the Hessian-fly caused a loss of $24,000,000 in two states in one year. The average annual loss to apple-growers from the codling-moth is $20,000,000, and millions of dollars are lost each year from attacks of boll-weevil, corn-root worm, cotton worm, webworm, cankerworm, bark beetle, plant lice, warble fly, and hundreds of other creepers and crawlers, each multiplying after its own kind, and at the rate of millions a minute, and every one of them hungry from start to finish.

Practically, we are told, every kind of plant has certain insects that naturally feed upon it and tend to hold it in check, and, as man produces more of a certain kind of plant, nature produces insects to destroy it. In many instances the withdrawal of the natural food of some species of insects forces them to take another, which may be a cultivated crop.

It is here that the birds, if undisturbed, come in to maintain the balance. To kill the birds is to allow these insect pests to increase and destroy the cultivated crops to which they have turned from their natural food.

Until recently the destruction of bird life in the South Atlantic and Gulf States went on at an alarming rate. There were no effective protective laws, and little value was set upon the birds. The nighthawk, one of the most valuable of the insect destroyers, and one that is absolutely harmless, was wantonly shot by men and boys simply to display their marksmanship. Mocking-birds, cardinals, and indigo finches were trapped by the thousands for the trade. In these states these God-given friends of the farmer and fruit-grower did not seem to have a human friend. Robins, during their migration, were thrashed out of trees by night, blinded by torches, beaten to the ground by brush and sticks, and sold in the markets for a nickel a dozen.

But when the boll-weevil came to practically wipe out thousands of acres of cotton and even threatened the almost immediate end of the industry, and other insects began to seriously menace other agricultural industries, then these people began to pay some attention to the value of the birds.

You can't always make a man stop and consider by hitting him in the head, but when you hit him hard in the pocket you begin to make him do some thinking. Well, the men of those Southern States, when the boll-weevil, armyworm, and other destructive insects got busy, began to sit up and take notice. Then they got together and called on their

State legislatures to pass laws for the protection of the beneficial birds, and the result is that every South Atlantic and Gulf State has to-day a thoroughly good law for the protection of the non-game birds known to be beneficial or harmless to agriculture, and are enforcing them with splendid results.

The State of Louisiana not only has a bird protective law that we might well copy, but her Audubon society has secured the setting apart of several islands as breeding grounds for birds, and is guarding them from plume-hunters and similar outlaws.

A man said to me the other day: "Do you believe in protecting all the birds?" This is as good a time as any to answer that question, and I answer it for myself and the Audubon societies at the same time. We believe in protecting absolutely every bird that does more good than harm, and in humanely destroying those that are shown, by reliable evidence, to be harmful and of no particular benefit. I say "humanely" because we are emphatically opposed to the slaughter of the innocent with the guilty, and I am glad that the ordinances in several San Joaquin Valley counties no longer permit the putting out of poisoned water for birds, a practice to which our peerless mocking-bird is almost certain to fall a victim, while the birds that are doing the mischief usually escape. I know of localities in this State where the splendid song of the mocker, once poured out in ecstacy from hedge and housetop, is heard no more. The pan of poisoned water, made more attractive by the addition of a little sugar put in as a slight additional evidence that some of us have got to suppress a little of our native meanness before we are worthy to wear a halo, has taken the last beautiful victim that, with misplaced confidence in his human brother, made his home in the vine that shaded the cottage window, while the busy linnet is still alive, cheerful and plentiful as ever at the old stand.

The careful, investigating farmer will not kill birds on the strength of a conviction by mere circumstantial evidence. "Not long ago," says Mr. Way, "I came upon a man carrying two California thrashers that he had shot in the vicinity of his seed bed. He was growing orange stock and claimed that the thrashers were eating his seed. He was quite positive about it, and I was just as positive that he was mistaken. He said he had caught these very birds in the act, and because he couldn't convince me of the soundness of his position he got quite as much excited as it is safe for a church member to get and not shatter a commandment. I suggested that the matter could easily be settled by opening up the stomachs of the birds he had killed. In a minute or two we had the recent food of the thrashers before us. It consisted not of a single orange seed or even the sprout of an orange seed, but of several hundred small white grubs, sometimes called thread worms, such as breed and harbor in soil where stable litter is liberally used and which are destructive to seeds, bulbs, and roots of plants. This man had mulched his seed bed with stable manure and the thrashers were feeding on the grubs that were breeding therein, and making inroads upon his seeds, most of which they would probably have destroyed but for these birds. He was killing his best friend, who, though they might have pulled up a few seeds in their persistent search for worms, were doing him a splendid service for which they deserved his friendship and protection."

It requires long and patient study and observation in order to form anything like a sound conclusion regarding the food habits of birds. It is so easy to be deceived. In a bulletin issued by the Agricultural Department at Washington and entitled "Birds of a Maryland Farm," it is related that a farmer who was growing tomatoes for market claimed that the cat birds were destroying his crop. Observations by a biologist of the department were at the time being made on this plantation, and, as there were great numbers of cat birds in the tomato field, and many partly eaten tomatoes, it was a fair assumption that the birds were guilty. So the biologist shot a few of the cat birds and examined the stomachs. Not a bit of tomato was found. Some hours later more were killed in the tomato field, with like results. There were plenty of tomato worms and other insects injurious to the crop, but no vegetable matter in the birds' bill of fare. And yet the destruction of tomatoes went on. So the biologist put a man to watch the field, and soon the farmer's chickens were seen to march, in single file, through a hole in the fence and begin a raid on the tomatoes. The mystery was solved and the farmer convinced that the cat bird was his friend and not an enemy, as he had supposed.

The study of the food habits of birds is comparatively a new branch of agricultural science. One of the most important as well as remarkable of the early papers on this subject is by Wilson Flagg, published in the report on the agriculture of Massachusetts in 1861, entitled "The Utility of Birds," and which is based on the thesis distinctly stated in these words: "That each species of birds performs certain services in the economy of nature, which can not be so well accomplished by any other species."

Less than twenty years ago the subject of economic ornithology was taken up by the United States Department of Agriculture, and the story of the development of the subject, since that time, has been chiefly the story of the operations of the Division of Biological Survey. It is not within the scope of this paper to give even an outline of the work of that department, but bulletins, covering all the important investigations, are free for the asking. I may add that from the standpoint of economic ornithology the division may be said to have three functions: (1) To determine as accurately as possible the food of birds of economic importance; (2) To act as a court of appeal to investigate complaints concerning depredations of birds on crops; (3) To diffuse the results of its work and educate the public as to the value of birds. One important result of the investigations of the division showed that of the seventy-five species and sub-species of hawks and owls which occur in America, north of Mexico, only six were found to be injurious, while many were proved to be decidedly beneficial. Of the forty or fifty birds, exclusive of hawks and owls, thus far investigated, only the English sparrow is absolutely condemned.

Professor Atwater, always a careful and conservative authority, estimates that the birds of the State of Texas will consume more than 35,000 bushels of insects each day. You will agree that, if they are doing so well as that, they are earning their protection and their share of the fruit they take besides.

This estimate certainly seems low enough when we take into consideration the quantity of insects that some of our birds have been known to devour within a few hours. For example, the stomach of a single quail contained 101 potato-beetles and that of another quail 500 chinch-bugs. A cuckoo had eaten 217 webworms, and the stomach of a robin contained 175 caterpillars. The breakfast of four chicadees consisted of 1,028 eggs of the cankerworm, and four others had eaten 600 eggs and 105 mature insects. A barn swallow will destroy from 5,000 to 10,000 flies and other insects every week, and a record has been made of a pair of chipping sparrows feeding their young more than two hundred times in a single day, and mostly on insects injurious to agriculture. I might say here that the amount of food consumed by young birds in the nest is not generally appreciated. At first nestlings consume more than their own weight of food in a day, and if you have ever successfully raised a young bird by hand you will remember that a ten-minute intermission between meals was about what it considered the limit.

The young of a pair of jays observed by Dr. Brewer were fed half a million caterpillars in a single season, and a young robin kept in captivity required sixty insects a day. A mother wren fed her little ones 111 insects in four and a half hours, and the crop of a single mourning dove contained 7,500 weed seeds.

In an orchard infested by cankerworms Professor Forbes shot seven specimens out of a flock of thirty cedar birds. The stomachs of all these were full of worms, averaging 100 each, so that it was estimated that this flock would destroy 90,000 of the pests if they stayed in the orchard a month. If those cedar birds ate some of the farmer's fruit, don't you think they justly earned it?

Government investigations regarding the economic status of birds in California have been going on for some time, but are yet far from complete. Professor Beale has spent the past summer mainly in the northern part of the State. Almost everywhere he says he has found the farmers defending the birds. "They destroy some of our fruit," many of them said to Mr. Beale, "but we can't do without them."

You all know the Western Black Phœbe, a familiar visitor about our homes and a bird we can all love and protect without any reservation. Over 93 per cent of its year's food consists of insects, and chiefly of insects injurious to man's interests. It is not only the friend of man, but of his horses and cattle as well, for the stable and pasture are among its chosen feeding grounds. The knowledge of the exceeding usefulness of this bird should win for it more friends, who shall encourage its increase in every possible way.

Belonging also to the fly-catching family is the Western Pewee, seen frequently feeding about reservoirs and in other localities where winged insects are common. It is a persistent destroyer of gnats, mosquitoes, and other insects troublesome to man and domestic animals. The pewee is said to carry insect food to its young almost every minute of the day. One of the most beautiful and sympathetic chapters in the wonderful work of the great Audubon is that on the pair of pewees that nestled in the mill near his Pennsylvania home. The Audubon society intends to reproduce this passage as an educational leaflet for use in the schools throughout the State.

We, of the valley country, are more fortunate than our neighbors of the foothills in having the splendid help of the Western Meadowlark, sweet of song as well as beautiful and useful. "The farmer can not afford," says Dr. Judd, than whom there is no better authority on the economic value of birds, "to dispense with the services of the meadowlark, for it busies itself all summer eating grasshoppers and noxious insects, and when autumn comes varies its diet with rag-weed, pigeon grass, and other weeds. The record of the food of the meadowlark is unusually full and complete, and its great destruction of grasshoppers, the cutworms and other caterpillars, and the absence of all depredations other than the appropriation of a few scattered grains, indicate that this bird is of extraordinary economic value. It supervises our grass lands more closely than almost any other species and is therefore of special value to the alfalfa grower, and should be carefully protected from the shotgun and bird-egg hunter. Notwithstanding the great value of the meadowlark to the farmer and fruit-grower, it was not long ago the prey of pot-hunters, having, until recently, no legal protection in California, and even at this day, with all the data at hand confirming its wonderful value as a destroyer of some of the worst insects the farmer has to combat, men of much wealth in dollars and lands but poor in gratitude and humane instincts have been known to put out poison for the destruction of these beautiful and valuable songsters because they had picked up a few cents' worth of scattered grain.

"The upland plover, which frequents the inland meadows, is very unfortunately still classed as a game bird and killed for sport, though it has little good and great economic value. It, with the mourning dove, should be stricken from the game list and encouraged to multiply in our fields and about our homes to serve the useful purposes for which the Creator of all things has so wonderfully contrived.

"In 601 stomachs of the valley quail examined by the United States Biological Survey grapes formed only one per cent of the annual food, and the total proportion of all kinds of fruit was only seven and one half per cent. Nearly five per cent of this was *Rhus aiversiloba*, a wild fruit, common in our foothill cañons. Of the yearly food of the 601 quail referred to a little over six per cent was grain, thus proving that the loss to the grain farmer from this source is small. Nearly sixty per cent of its food is the seeds of weeds, more or less troublesome to the farmer. From 500 to 600 seeds of the bur thistle are often eaten at a meal and the destruction of this seed is highly beneficial to the farmer, for this thistle is one of the most difficult to control. It should be worth our while to protect the valley quail on our lands for its usefulness in the destruction of the seeds of this thistle alone. Tar-weed is another favorite source of food, and one stomach collected at Watsonville contained 700 of these seeds. Another stomach collected from the same locality contained 200 tiny seeds of dog fennel, or cayweed, and as many as 900 seeds of the turkey mullein have been found in a single bird. Wild carrot, wild lettuce, pig-weed, black mustard, red sorrel, curled dock, bur clover, and alfilaria all go into the valley quail's bill of fare.

"The animal food of the valley quail consists of a number of leaf-eating beetles, some of them very dangerous to trees and plants, also ground beetles, ants, caterpillars, cut-worms, measuring-worms, leaf-bugs, bugs of the chinch-bug family, assassin-bugs, burrowing-bugs, leaf-hoppers, tree-hoppers, plant lice, stink-bugs, bugs of the genus *Scolops*, and various other bugs with names as long as your arm and appetites in proportion. The animal bill of fare also includes flies, spiders, and snails. The greatest destruction of insects by quail occurs while the young broods are being raised, animal food forming a much larger proportion of young than of old birds of this species.

"Returning to the grape question, we do not deny that there may be, owing to absence of natural food or other unusual conditions, some damages to vineyards from valley quail, but very often mutilated bunches of grapes supposed to be due to the presence of quail in the vineyards would be found, on closer investigation, to have been damaged by other birds or mammals, several of which vary their diet with grapes. The strongest evidence in favor of the quail is the fact, well established by those who have examined birds killed in vineyards, that grapes are rarely found in the crops, and that poison-oak berries are a staple diet when grapes are at their best. All wild birds prefer wild fruits to cultivated sorts, and it is only when man has destroyed the natural food plants that they are driven to his cultivated fruits.

"Unless the prosecution can produce something better than the evidence it has heretofore put up we shall have to give the valley quail the benefit of the doubt and pronounce it not guilty, except when other food is absent and it is driven to grapes by hunger. When driven to it man has been known to eat army mule, with great relish, but you wouldn't class it as a food for which he would acquire a great and unsatisfiable desire."

Some of the most valued friends and members of our Audubon societies were once hunters of nestling doves. When they came to realize the cruelty of what they were doing they quit the practice and took a strong stand for the preservation of these useful birds. One of these in particular, a resident of Pasadena, reported by our State secretary, though a sportsman and dealer in guns and ammunition, persuaded many young man last July to give up dove-hunting altogether. When they would come in to rent a gun or buy shells, he would say: "Boys, don't do it. It isn't sportsmanlike to kill nestling birds. If you must go after them now, you don't need a gun. Just take a stick and a basket."

I desire to remind you of the value of the wrens, the thrushes, the bushtits, the blackbirds, and even the jays, which, though they are the "practical politicians" of the bird family, taking as they do everything in sight, still have their good qualities; of the birds that plant our forests and then guard them from destruction by hoards of insects; of the owls that hold destructive mammals in check; of the beneficial hawks and eagles that destroy gophers and ground squirrels.

Even under normal conditions birds have to encounter grave perils that many of them are unable to withstand. Young birds are subject to many dangers before reaching maturity. Young and old fall a prey to their enemies of the wild. Heavy rains destroy many more. Electric wires destroy many thousands. Besides these causes there are others still at work which tend greatly to decrease the number of birds possible under existing conditions.

To a very large extent these agencies are the result of human greed, cruelty, and ignorance, and the havoc they commit may be avoided by proper laws based upon and supported by the opinion of an enlightened public.

PRESIDENT COOPER. The next paper on the program is "A Further Plea for Selection," by Leonard Coates.

A FURTHER PLEA FOR SELECTION.

BY LEONARD COATES, OF MORGAN HILL.

There has been, of late, an effort on the part of some biologists to disparage the Darwinian theory of natural selection by quoting the mutation theory of Hugo de Vries. We know that all nature is at war—the animal kingdom on the vegetable kingdom, and the latter, as bacteria, preying on the animal kingdom. In both of these kingdoms there is also a great civil war waging, ending, as Herbert Spencer had it, in the "survival of the fittest." That is "Natural Selection." Hugo de Vries's theory is, that at some period in a plant's life it is liable to produce an offspring which differs in a marked way from its parent. This he calls a "mutant," and it is, he says, the beginning of a new variety. Any observing horticulturist is aware of what all old gardeners call "sports" occurring, and Professor de Vries, it would seem, simply places this fact upon a broad plane as an accepted theory of horticulture, called "mutation." It in no way conflicts with Charles Darwin's theory of natural selection, but is merely incidental to it, these "sports," or "mutants," being still subject to the more immutable law of the survival of the fittest.

Pedagogues or professors, call them what you will, often wrangle over what appear to us laymen to be trivialities. Professor S. W. Fletcher of Michigan, for instance, says he believes in

PEDIGREED STOCK

as applied to plants, but does not like the term, which, he says, should be "selected." Professor John Craig says the term "pedigreed" should never be used, unless both parents are known. At the same time he says that no variety described by the American Pomological Society is pedigreed, making the analogy between a herd of cattle and a garden of plants absolute and arbitrary. Whereas, in one flower may be a perfect blossom, both male and female, and by simply following the law of selection the variety may be improved, so that there can be no two names of parents. In other words, according to this line of reasoning, pedigreed plants are nothing but the result of artificial fertilization between two distinct varieties, which may be absolutely worthless, and yet entitled to the term "pedigreed." This term has been and is used by horticulturists all over the country to denote a continuation by selection of all the fixed characteristics of a known type or variety. No other name has been suggested, and to attempt to adhere strictly to the analogy between animals and plants would lead us into inextricable confusion.

We all believe, however, in "Plant-breeding"; in the fact that variations occur; that if we select and isolate those variants we can perpetuate the marked peculiarities they evince, whether it be an improvement or otherwise; and it is in the endeavor to impress this fact upon you that I make these remarks.

It is within the province of every farmer to improve the crop he grows; he will benefit himself, and he will benefit those who succeed him still more. Eighty years ago a Spanish botanist, Mariano Lagasca, visited a friend in the island of Jersey. He pointed out to him in his wheat field a dozen or more varieties of wheat, and suggested that seed be kept distinct and saved for further trial. This was done, with the result that a variety was secured much superior to any known sort, and which became the leading variety of wheat cultivated in France. To-day, the Oregon Experiment Station is doing the same work—"selecting" to find a wheat that is drouth-resisting, hardy, and of best quality.

Roland Morrill, the great peach-grower of Michigan and Texas, claims that his success is largely due to growing his peach trees on what he calls the "pedigree" plan.

R. M. Kellogg, one of the largest strawberry growers in the United States, says: "The term 'pedigree strawberry' is especially applicable, because it takes many years to breed it up by high tillage, selection, and restriction. A pedigree plant is one known to have received every possible attention in the way of food and culture, restricted in its fruitage to strengthen its seed- and fruit-producing organs, and these qualities were acquired by the constant selection of those showing the greatest degree of improvement through a long series of years. It is simply the recognition of the individuality of a plant and makes ancestry of value, because characteristics are more surely transmitted through runners and buds than by seeds."

Professor L. H. Bailey, in his "Plant-Breeding," discusses from a scientific standpoint the Darwinian theory, the Mutation theory, and Mandel's theory of heredity. It is needless, for all practical purposes, to attempt to follow these learned men; but Mandel's theory is, simply, that even the hybridizing to produce new types produces results only in accordance with a fixed law. So, after all, the most skillful hybridizer is only a mechanical instrument, possessing a little knowledge, but totally unable to produce variations contrary to a prearranged system about which he is very much in the dark. Or, again, the very careful student of nature may observe, in his travels, all of these, or similar, variants being produced entirely without his or any one's intervention.

The practical application of all this, at a fruit-growers' convention, is to encourage the of fruits by selection. Many of the most valuable fruits we grow in California are the results of selection. The Muir peach, Lovell peach, Phillips cling, Chapman and Advance cherries, P. Barry pear, Clyman plum, Tilton apricot, Cook's and Skinner's apples, and many others, are natural selected seedlings. And so with our almonds and walnuts; the Hatch seedlings, I X L, Ne Plus Ultra, and Nonpareil, Lewelling and Drake, and some others, are the commercial almonds of California. Whatever the French varieties of walnuts may prove to be, the fact remains that all the thousands of carloads of splendid nuts that have been grown in the State and which have made California famous, are natural selected California seedlings. All progressive and broad-minded horticulturists recognize this fact, and look to a continued steady improvement in our commercial varieties, mainly through selection.

Half a century ago Mr. Charles Mock of Petaluma, after extensive experiments with the best varieties of apple from the Eastern states, said: "The process of acclimation is not by change on an individual transposed from its native locality, but on the repeated processes of reproduction from seed."

Every fruit-grower can aid in the work, and should seek to do so. All promising seedlings should be sent to the office of the Secretary of the Horticultural Commissioner, where a committee of experts may be called to act upon them. There is no other way to do it; propagators should never pass upon their own introductions.

We may go back a hundred years or more and shall find that all the practical growers and those who have succeeded in giving the world the best varieties of fruits, have followed selection in its simplest form. Van Mons spent his life in producing pears by careful and intelligent selection of seedlings; Knight of England did the same with other fruits; Thomas Rivers, also of England, and his son and grandson after him have put upon the market the best plums, and many of the best cherries, peaches, and nectarines that are known and eaten; B. S. Fox of San José worked in the same way, originating several pears which are recognized as standard; W. H. Chapman of Napa did the same with cherries, merely selecting the finest fruit from the best trees, thinning it out, and sowing the seed of what remained. He died a poor man, unknown, while the cherry-growers of California are making thousands of dollars every year from the fruits he gave us. Phillips of Yuba, who gave us the cling peach bearing his name, died the other day in the county poorhouse. Dick Burton of Vacaville has now in his orchard a collection of seedling plums, prunes, pears, and apples which are, as a whole, superior to any yet raised in the State, and some may prove of the greatest value. But he is a careful man, and will not propagate for the market until years of testing demonstrate their peculiar merit.

All I would say is, go on with the good work; let every grower try to improve something; select a specimen tree of some fruit which seems nearly perfect; thin the crop very heavily, and save the seed; give it the best of care, and select the most promising seedlings for further experiment. Let them fruit, and the chances are an improved variety will result. The opportunities are great for extension of this work, and the outlook is very encouraging.

THE FRUIT INDUSTRY OF TULARE COUNTY.

BY P. D. FOWLER, OF TULARE.

Tulare Valley was first seen by white men in 1826. Jedediah Smith, of New York, entered it near its southern extremity at the head of twenty-five trappers, whom he brought with him from St. Louis. For many years thereafter the vicinity of Tulare Lake was frequently visited by hunters and trappers; but hunters and trappers, while ready enough to detail their adventures with wild beasts and wild men, were very reticent about the character of the country visited. They viewed the advance of civilization with scarcely more favor than did the aboriginal red men.

The Spaniards and Mexicans who settled the coast counties were even less curious about the great interior valleys of the State. It is said that a superstition was current among them that the great valley was the exclusive property of the devil, and that whosoever ventured within his territory was never permitted to return. So it was that the Spaniards contented themselves with the territory lying westward of the Mount Diablo range of mountains, tacitly agreeing with Satan that the country bearing his name should be left in his possession.

This state of affairs has proven most fortunate to the Americans who came to settle the country within the last few years, for they found it for the most part unincumbered by Spanish grants, the primal curse of other sections of the State.

In the winter of 1852 the California Legislature provided for the organization of a new county, to be known as Tulare. The territory to be included within the boundaries of this county was what now comprises Tulare, Inyo, Kern, Kings, and the south half of Fresno counties.

The first election ever held in Tulare County was on July 10, 1853, at which election 109 votes were cast. Since that memorable occasion Tulare County has been gradually developed: first into one of the most prosperous stock countries, and then into the banner wheat county of the State, and to-day one of the best counties for diversified farming.

The soil and climate of Tulare are preëminently adapted to the production of stone fruits of all kinds, with the possible exception of cherries, which do not appear to thrive in the valley, though they undoubtedly will in the higher foothills and lower mountain flats. Cherry trees grow well enough, but the cherries fall off before ripening. But peaches, plums, apricots, nectarines, prunes, etc., grow very rapidly and bear tremendously. Tulare is unmistakably a great peach country. No part of the world can show a superior article from any point of view, and certainly no other country can grow such quantities of them. If left to themselves the trees will bear until their limbs bend over and trail upon the ground, and split off the trunks, wither and die. One of the most irksome duties of the Tulare fruit-grower is to thin out his fruit. A very important point in Tulare's favor is the fact that our peaches, and other stone fruits as well, ripen fully two weeks earlier than those grown in Southern California, and there are only one or two small neighborhoods in the State that get fruit into the market as early as Tulare, and none earlier. This fact holds true with each variety, clear through the season, giving Tulare the top of the market in Southern California and the entire East.

The prune orchards of Tulare County are very productive. The writer has gathered and cured twenty tons of dried prunes from three hundred trees.

The sun-loved shores of the Mediterranean offer to the vine no finer soil and climate than the warm plains of Tulare. The abundant water supply from the snow-filled cañons of the mighty Sierras gives health to the vine and size to the berries, while the long summer heat fills the grape with all lusciousness. When the early September days pour a torrid heat upon the plains, the rich clusters put on a golden tint—the royal amber of full ripeness. Sun and water and warmth can do no more, the vintage time has come.

That county in California is poor indeed which, in this era of citrus booms, has no "citrus belt." From San Diego to Shasta, up through the interior and back down the western coast and eastern border line of the State, there has gone up from every county one universal invitation to all the world to "come and see our citrus belt." Tulare has a citrus belt also, and a good one. The boundaries of this belt, or the extent of territory available for the profitable production of semi-tropical and citrus fruits in Tulare County, can not be given, but the area is very large. All along the line of the Sierra foothills for the sixty miles that they extend through this county are innumerable little nooks, coves, and valleys that are practically frostless. Indeed, it would seem that almost anywhere above 300 feet elevation and below 2,000 feet and in situations not too much exposed to the early morning sun, citrus fruits may be grown with profit.

The first orange trees grown in the county, so far as the writer is informed, were planted by the late Mr. D. Gibbon, of Plano. It was, we believe, in 1863 that a squad of United States soldiers chanced to be at Porterville, and one of them gave an orange or two to one of Mr. Gibbon's little girls. The oranges were promptly eaten, but their seeds were saved, planted, carefully tended and reared, to become large, thrifty trees loaded down with golden fruit. From one of these trees fruit was plucked in 1883, taken to the Citrus Fair at Los Angeles, and there awarded first premium for seedling oranges.

Mr. Gibbon's success in starting orange trees induced others in the neighborhood of Porterville to do likewise, and as a result one of the most prosperous orange belts in California has been established. Last year there were shipped from this district over 1,600 cars of oranges, and this year there will be about the same. There were 123,720 orange trees shipped into this county and planted last spring, besides what was bought from the local nurseries. About 3,000 acres were planted last spring, and a much heavier planting is to be made in the spring of 1907.

All the navel oranges are ripe and sold in this county before Christmas. The trees are all healthy and thrifty. The fruit is clean and bright-colored. Orange scale is very scarce. The only scale that has given any trouble is the cottony-cushion scale, and we have been able to keep that under control with the *Vedalia cardinalis*. We have distributed the past season 213 colonies of these ladybirds in the citrus orchards of the county.

Our deciduous orchards are in good, thrifty condition, except for pear blight, and shot-hole fungus on peach trees. Our peach-growers are going to spray their trees with Bordeaux mixture in December, and we believe this trouble can be controlled.

Our vineyards are in fine condition and have yielded an average crop the past season, and prices have been good.

Our prune orchards have borne heavy crops, and while the price was low during part of the season, it is good now.

Our fruit-growers are prosperous and well satisfied with present conditions, and hopeful for the future.

REPORT OF COMMITTEE ON LEGISLATION.

PRESIDENT COOPER. At the Convention held at Santa Rosa last year, a committee on legislation was appointed. None of the committee is present, but Judge Carroll Cook sends his excuse that he had to attend court and could not be here. Judge Mills of Riverside also sends us word that he was summoned to Los Angeles to be there on Friday, and therefore could not be present. They have sent in their recommendations for changes in the quarantine laws. The Secretary will read them.

To the President and Members of the Thirty-second Fruit-Growers' Convention.

GENTLEMEN: We, your Committee on Legislation, appointed at the Thirty-first Fruit-Growers' Convention, held at Santa Rosa, December, 1905, would report, as follows:

In accordance with your request, we have looked into the matter of the laws and the suggestions which have been made for amendments thereto and changes therein; and do recommend as follows:

1st. Inasmuch as a county horticultural commission composed of three men has been found cumbersome, inefficient, and expensive, we would suggest that the existing law be so amended as to provide for the appointment of one competent man as horticultural commissioner in each county.

2d. We would recommend that the law be so worded that political considerations shall not enter into such appointment, but that qualification only be considered.

3d. We would recommend a new section re-creating the office of State Quarantine Guardian, which was provided for in the old law organizing the State Board of Horticulture, but omitted in the present law establishing the Horticultural Commission.

The County Horticultural Commissioners should be appointed State Quarantine Guardians, receiving their powers from the State Horticultural Commission, after having passed an examination as to quality and fitness. Should they fail to pass a proper examination as to their fitness for State Quarantine Guardians, then their appointment as County Horticultural Commissioners should be revoked. The appointment of County Horticultural Commissioners as State Quarantine Guardians gives them extended powers and they could serve as State as well as county officers, and could do much better work than where they acted in the limited capacity of county officials.

4th. Upon complaint made by the State Horticultural Commissioner to any Board of Supervisors alleging and proving that the County Horticultural Commissioner is incapable, inefficient, neglectful of his duties, or for any other good cause, the County Supervisors should declare his office vacant and may reappoint another commissioner in his place.

5th. By and with the consent of the Supervisors, the Horticultural Commissioners of the different counties should have power to subdivide their counties into horticultural districts and appoint horticultural inspectors for such districts. The labors of such horticultural inspectors should be under the direction and control of the County Horticultural Commissioner. They should be removable at any time by the County Horticultural Commissioner, or by the County Supervisors. The County Horticultural Commissioners should be required to keep a record of their official actions, and to furnish copies of the same to the State Horticultural Commissioner, and in the case of the discovery of any new pests or diseases, or the serious outbreak of any already established, should be required to give immediate notification to the State Horticultural Commissioner, and it should be his duty to work in conjunction with them for the control of such pests or diseases. This should also apply to the introduction and control of noxious weeds.

6th. The law fixing the compensation of local inspectors at $2.50 per day was enacted at a time when there was less demand for labor than at present and when money had greater purchasing power. This compensation is altogether inadequate for the class of service required, and should be fixed at not less than $3 per day, or as much as may seem reasonable to the Supervisors after consultation with the County Horticultural Commissioner.

7th. In cases where a petition, properly signed, is presented to the Supervisors of any county, in accordance with the law, and such Board of Supervisors fails or neglects to comply with the law providing for the establishment of Boards of County Horticultural Commissioners, it should be the duty of the State Horticultural Commissioner to commence action against such Supervisors to compel them to perform their legal duties in the matter, and the law should be so amended as to authorize and require the State Commissioner of Horticulture to take action in such case.

8th. The law, as it stands at present, gives the State Commissioner ample authority to prevent the entrance of any diseased or infested nursery stock, fruit, or other forms of vegetables from sections outside the State. There are, however, very many sections and counties within the State in which diseases and pests may be found which are not found in other sections. In such cases, the law should provide some means by which the non-infested sections can protect themselves against infested districts, and we would suggest that it be so amended as to give the State Horticultural Commissioner power to protect clean districts within our own State.

The above recommendations were referred to a committee appointed by the Chair, and consisting of J. W. Jeffrey, S. A. Pease, and R. P. Cundiff, for consideration and report; which committee, after taking the same under advisement, reported as follows:

MR. PEASE. The committee has decided that, inasmuch as we are about to leave for home and have no time to consider the matter submitted by the committee appointed one year ago, we recommend leaving this matter for the future, and if the matters complained of are true, that President Cooper draft a bill that would improve these conditions and submit it to the Legislature. I make a motion that this whole matter be referred to President Cooper to be treated as he considers best, and that he be empowered by this convention to formulate a bill covering the points raised in the committee's report, and any additions that he wishes to make.

MR. DORE. I second the motion.

Carried.

THE NEXT MEETING-PLACE.

The Secretary read a telegram from the Chamber of Commerce of Chico, asking that the next Convention be held in that town.

MR. JEFFRIES. I renew my invitation of a year ago that you will come to Los Angeles for your next meeting.

MR. SHAW. Chico is my home, and we would be pleased to have you come there.

PRESIDENT COOPER. The time and place are fixed by the State Horticultural Commissioner, according to conditions and circumstances that may take place between this and the time of the next Convention. Probably we may give two Conventions the coming year—a spring convention held in Southern California, and a fall convention in the north, among the deciduous fruit districts. The matter is left to the Horticultural Commissioner. One thing, however, is necessary, and that is that the place be accessible by rail and that there be a sufficient number of hotels where guests can be accommodated.

The Convention then adjourned *sine die*.

ELLWOOD COOPER, President.

JOHN ISAAC, Secretary.

VOTE OF THANKS BY THE PACIFIC COAST NURSERYMEN'S ASSOCIATION.

At a special meeting of the Pacific Coast Nurserymen's Association, a unanimous vote of thanks was extended to the citizens of Hanford for the delightful entertainment at Odd Fellows' Hall and the banquet following, for the rides into the country, and for the general kind hospitality shown. A vote of thanks was extended to the daily press of Hanford for the liberal notices given to the proceedings of the Convention, and to the officers of the Horticultural Commission for faithfulness and efficiency in the work of this meeting. A vote of thanks was also extended to the officials of the Southern Pacific Railroad Company for excursion rates and stop-over privileges.

F. W. POWER, President.
C. A. TONNESON, Secretary.

INDEX.

Adoxus vitis, 22.
Alameda County, report of Horticultural Commission, 273.
Aleyrodes citri, the white fly, 16.
  in Florida, 16.
  in Mississippi, 16.
  in Louisiana, 16.
Alkali land, reclamation of, 251.
Almonds, yield for 1905, 30.
  crop of 1906, 34.
Anarsia lineatella, 22.
Ants, prevalent in houses, 230.
Aphis cucumaris, 22.
  mali, 21.
  phorodon humuli, 22.
  prunifoliæ, 22.
Apples, crop of 1905, 29.
  crop and shipments for 1906, 33.
  decrease of codling-moth in, 33.
Appropriation for beneficial insects, 14.
Apricots, crop of 1905, 28.
  crop of 1906, 31.
Aramigus fulleri, 22.

Beneficial insects, introduction of, 14.
Bermuda-grass, on alkali land, 258.
Black peach aphis not spreading, 228.
Black scale (Saissettia oleæ, 23, 193, 223.
Brown apricot scale, 23.
  Eulecanium armeniacum, 223.
Brown bear caterpillar, damage to garden plants, 226.
Brown-tail moth in Massachusetts, 237.
Bryobia pratensis, the almond mite, abundant in upper valleys, 24.
Bryobia sp., abundant in interior valleys, 24.
Butte County, report of Horticultural Commission, 275.

Cabbage butterfly, damage from, 227.
Cabbage louse, abundant during the season, 228.
Caliephialtes messer, parasite of the codling-moth, 9, 14, 231, 232.
Cankerworms, recommendations against, 225.
Carpocapsa pomonella, 22.
Cherries, crop and shipments for 1905, 28.
  crop and shipments for 1906, 31.
Cherry slug, remedy for, 226.
Chrysomphalus aurantii, 23.
Chrysomphalus aurantii citrinus, 23.

COCCIDÆ, scale insects of California, 23, 155.
  List of California families of, 157.
  Aclerda californica, 194.
  Aspidiotus æsculi, 204.
    hederæ, 206.
    juglans-regiæ, 208.
    perniciosus, 209.
    rapax, 210.

COCCIDÆ—*Continued.*
  Aulacaspis rosæ, 202.
  Ceroplastes ceriferus, 183.
    cirripediformis, 181.
    floridensis, 182.
    irregularis, 183.
  Ceroputo bahiæ, 174.
  Chionaspis ortholobis, 195.
    pinifoliæ, 196.
    quercus, 197.
    wistariæ, 197.
  Chrysomphalus aonidum, 213.
    aurantii, 214.
    aurantii citrinus, 216.
  Coccinæ, subfamily, 179.
  Coccus hesperidum, 186.
    ventralis, 187.
  Diaspinæ, subfamily of, 195.
  Diaspis bromeliæ, 199.
    carueli, 200.
  Epidiaspis piricola, 204
  Eriococcus adenostomæ, 172.
    araucaria, 172.
  Erium eriogoni, 178.
  Eucalymanatus perforatus, 184.
  Eulecanium armeniacum, 187.
    cerasorum, 188
    crawii, 190.
    pubescens, 191.
    pruinosum, 190.
    tulipiferæ, 192.
  Glossary of terms used in describing Coccidæ, 162.
  Gossyparia spuria, 170.
  Hemichionaspis aspidistræ, 203.
  Howardia biclavis, 198.
  Icerya purchasi crawii, description of, 165.
  Icerya purchasi maskelli, description of, 165.
  Kermes austini, 168.
    cockerelli, 168.
    galliformis, 169.
    nigropunctatus, 169.
  Lepidosaphes beckii, 217.
    crawii, 220.
    ulmi, 220.
  Orthezia insignis, 167.
  Parlatoria pergandii, 221.
  Physokermes insignicola, 195.
  Phenacoccus artemisiæ, 173.
    stachyos, 173.
  Pollinia pollini, 168.
  Pseudococcus aurilanatus, 175.
    citri, 175.
    duplex, 212.
    longispinus, 176.
    maritimus, 177.
    quercus, 177.
    ryani, 178.

COCCIDÆ—*Continued.*
  Pulvinaria camelicola, 180.
    innumerabilis, 179.
    psidii, 180.
    rhois, 181.
  Ripersia villosa, 178.
  Saissettia hemispherica, 192.
    oleæ, 193.
  Scale insects, description of species, 161.
  Xylococcus quercus, 166.

Codling-moth (Carpocapsa pomonella), 22.
  not so abundant as usual, 224.
  parasite (Caliephialtes messer), 14, 231, 234.
Comys fusca, parasite of brown apricot scale, 28, 223.
Consular reports, 11.
Contra Costa County, report of Horticultural Commission, 276.
Corn-worm, not increasing, 227.
Coryneum beyerinkii, fungus of the peach blight, 239.
Cottony-cushion scale (Icerya purchasi), 23, 224.
Cutworms, 22.
  large quantities in the season, 227.

Drainage of alkali lands, 258.

Earthquake, insectary destroyed by, 15.
El Dorado County, report of Horticultural Commission, 278.

ENTOMOLOGY, in outline, 37.
  Abdomen, and its functions, 54.
  Acalyptrate muscidæ, the fruit-flies, 127.
  Acanthiidæ, bed-bugs and flower-bugs, 77.
  Acroceridæ, a family of flies, 122.
  Aculeata, suborder of Hymenoptera, 141.
    the stinging Hymenoptera, 147.
    families included in, 148.
  Ægeriidæ, peach-root borers, 111.
  Agaristidæ, day flying moths, 106.
  Aleyrodidæ, description of, 87.
  Aleyrodes citri, the white fly of Florida, 87.
  Anarsia lineatella, the peach-twig borer, 114.
  Anosia plexippus, the Monarch butterfly, 101.
  Anphomyiinæ, cabbage-maggots, etc., 127.
  Antennæ, various forms and uses, 49.
    difference in, in moths and butterflies, 98.
  Ants, families of, 149.
  Aphids, extraordinary fecundity of, 85.
  Aphididæ, plant-lice, decription of, 84.
  Aphidius, a parasitic Hymenoptera, work on aphids, 146.
  Apina, the bees, 153.
  Apple-borer, the round-headed, 137.
  Apple-tree borer, 133.
  Arachnida, animals belonging to the, 40.
  Aradidæ, the flat bugs, 77.
  Arctiidæ, woolly bears, 106.
  Arthropoda, description of, 39.
  Asilidæ, robber flies, 122.
  Bag-worms, description of, 110.
  Bean-weevil, 136.

ENTOMOLOGY—*Continued.*
  Bees, description of, 153.
  Bee-moth, destruction from, 113.
  Beetles, description of, 129.
  Belostomidæ, electric-light bugs, 74.
  Bembecidæ, burrowing Hymenoptera, 152.
  Berytidæ, stilt-bugs, 78.
  Bibionidæ, March flies, 121.
  Big bedbug, danger from, 76.
  Birds, destroying grasshoppers in California, 66.
  Blastobasidæ, a family of moths, 114.
  Blepharoceridæ, net-winged midgets, 119.
  Blister beetles, used in medicine, 139.
  Blowfly (Caliphora vomitoria), 127.
  Bombycidæ, silkworms, 109.
  Bombylidæ, bee-flies, 122.
  Bot-flies, peculiar method of reproduction, 124.
  Braconids, parasitic on aphids, 84.
  Braconidæ, parasitic Hymenoptera, 145.
  Braulidæ, the bee louse, 128.
  Bruchidæ, injurious to stored seeds, 136.
  Bugs, the true, 72.
  Buprestidæ, a family of wood-boring beetles, 133.
  Burying beetles, habits of, 132.
  Butterflies, description of, 97.
    five families of, 100.
  Butterflies and moths, difference in transformation, 99.
  Cabbage butterfly (Pieris rapæ), destruction by, 102.
    checked by parasitic insects, 147.
  Calandridæ, rice and granary beetles, 139.
  Calcididæ, family of parasitic Hymenoptera, 146.
  California locust, 66.
  Caliephialtes messer, parasite on the codling-moth, 143.
  Cankerworms, destructive in orchards, 109.
  Capsidæ, the leaf-bug, 78.
  Carabidæ, a family of predaceous beetles, 130.
  Carpet beetles, 133.
  Carpocapsa pomonella, the codling-moth, 114.
  Cecidomyiidæ, the gall-gnats, 121.
  Cerambycidæ, round-headed wood-borers, 136.
  Ceratocampidæ, a family of moths, 105.
  Cercopidæ, spittle-bugs, 82.
  Chalcosiidæ, a family of moths, 111.
  Cherry-slug, 142.
  Chigoe, a pest in warm climates, 128.
  Chiromonidæ, true midgets, 121.
  Chrysalis, pupa of butterflies, 60.
  Chrysididæ, the cuckoo-fly, 149.
  Chrysomelidæ, family of beetles, 135.
  Chrysopidæ, lace-winged flies, beneficial in orchards, 92.
  Cicadidæ, harvest flies, etc., description of, 81.
  Cicindelidæ, the tiger-beetles, 130.

ENTOMOLOGY—*Continued.*
- Cigarette-beetle, 134.
- Circulation, of insects, 56.
- Classification, method of, 42.
- Clavicornia, club-horned beetles, 131.
- Cleridæ, checker-beetles, 134.
- Click-beetles, 133.
- Clothes-moth (Tineola biselliella), 115.
- Coccidæ, new classification of, 90.
  - scale-bugs, destructive in California, 87.
  - subfamilies of, 88.
- Coccinæ, a subfamily of Coccidæ, 89.
- Coccinellidæ, the ladybird family, 137.
  - beneficial, introduced, 138.
- Cochlidiidæ, slug-like caterpillars, 110.
- Cockroaches, destruction by, 63.
- Codling-moth (Carpocapsa pomonella), 114.
- Cœlenterata, jelly-fish and coral, 38.
- Coleoptera, or beetles, 128.
  - division of, 130.
  - genuine, 130.
- Conchaspinæ, a subfamily of Coccidæ, 88.
- Coniopterygidæ, a family of Neuroptera, 92.
- Conopidæ, flies parasitic on bumble-bees, 124.
- Conorhinus sanguisugus, the big bedbug, 76.
- Coreidæ, the squash-bugs, 78.
- Corimelænidæ, the negro-bugs, 79.
- Corisidæ, the water-boatmen, 78.
- Corrodentia, the order including book-lice, etc., 94.
- Cossidæ, the goat-moths, 111.
- Cotton-boll weevil, 139.
- Crabronidæ, a family of Hymenoptera, 152.
- Crane-flies, destructive to grass and grain, 119.
- Cricket-like grasshoppers, 68.
- Crickets, 68, 69.
- Crustacea, description of, 40.
- Cuckoo-flies, habits of, 149.
- Cucujidæ, a family of beetles, 132.
- Culicidæ, the mosquitoes, 119.
- Curculionidæ, a family of beetles, 139.
- Curculios, 139
- Currant-borer (Alcathœ caudatum), 111.
- Cursoria, running Orthoptera, 62.
- Cyclorrhapha, a suborder of Diptera, 118.
  - families belonging to, 123.
- Cydnidæ, the burrowing-bugs, 79.
- Cynipidæ, the gall-flies, 143.
- Dactylopiinæ, a subfamily of Coccidæ, 89.
- Dalceridæ, a family of moths, 110.
- Dermestidæ, the carpet-beetles, 132.
- Dexiinæ, a family of flies, 126.
- Diabrotica, destructive in California, 136.
- Diaspinæ, a subfamily of Coccidæ, 89.
- Digger-wasps, description of, 150.
- Dioptidæ, represented by one species, 107.
- Diptera, order of two-winged flies, 52, 115.
  - description of, 115.
  - divided into two suborders, 118.
- Dixidæ, a family of flies, 119.
- Dragonflies, predaceous upon mosquitoes, 93.
- Drug-store beetle (Sitrodrepa panicea), 134.
- Dytiscidæ, a family of carnivorous water-beetles, 131.

ENTOMOLOGY—*Continued.*
- Earwigs, represented in California by Anisolabis, 70.
- Eastern peach root borer (Sanninoidea exitiosa), 111.
- Echinodermata, description of, 38.
- Elachistidæ, a family of moths, 114.
- Elateridæ, the click-beetles, 133.
- Elytra (wing covers), 53.
- Emesidæ, thread-leg bugs, 75.
- Engraver-beetle, losses caused by, 139.
- Ephemerida, order, description of, 93.
- Epiplemidæ, a family of moths, 109.
- Epipyropidæ, a family of parasitic moths, 110.
- Erythoneura vitis, grapevine leaf-hopper, 82.
- Evaniidæ, a family of parasitic Hymenoptera, 146.
- Eyes, compound in insects, 46.
- Fleas, 128.
- Flies, beneficial, 116.
  - destruction by, 116.
- Fruit-flies, in the United States, 127.
- Fulgoridæ, lantern-flies in the tropics, 82.
- Fuller's rose-beetle, 139.
- Galgulidæ, the toad-shaped bugs, 75.
- Gall-flies, the work of, 143.
- Galleria mellonela, the destructive bee-moth, 113.
- Gelechiidæ, a family of destructive moths, 114.
- Geometridæ, measuring-worms, 109.
- Goat-moths, destructive to trees, 111.
- Grapevine flea-beetle, 136.
- Grasshoppers, damage from in California, 66.
  - insects destructive to, 66.
  - meadow, 66.
- Gypsy-moth, 108.
- Gyrinidæ, a family of beetles, 131.
- Harlequin cabbage-bug, 79.
- Harvest-flies, 81.
- Hemerobiidæ, a family of Neuroptera, 92.
- Hemiptera, an order of insects, 70.
  - divided into three suborders, 71.
  - heteroptera, the true bugs, 71.
- Hepilaidæ, a family of moths, 115.
- Hesperiidæ, a family of butterflies, 103.
- Heterametabola, description of, 60.
- Heteroptera, a suborder of Hemiptera, 70.
  - the true bugs, description of, 72.
  - families of, 72.
- Heterocera, a suborder, including moths, 97, 103.
- Hippoboscidæ, parasitic on birds, 128.
- Holometabola, description of, 59.
- Homoptera, a suborder of Hemiptera, 70.
  - description of, 80.
  - families included in, 80.
- Horn-fly (Hæmatobia serrata), 127.
- Horse-flies, pest of domestic animals, 121.
- House-flies, 125.
- Hydrobatidæ, the water-striders, 75.
- Hydrophilidæ, the water-scavengers, 131.
- Hymenoptera, order, description of, 140.
- Ichneumonidæ, a family of parasitic Hymenoptera, 143.
- Insecta, animals composing the, 39.

ENTOMOLOGY—*Continued.*
  Insect life, changes in, 58.
  Insects, orders of, 43, 61.
    classification of, 41.
    divisions of, 45.
    eyes of, 46.
    heads of, different parts, 46.
    structure of, 45.
  Invertebrata, branches of, 38.
  Isoptera, order including the white ants, or termites, 94.
  Jassidæ, leaf-hoppers, destructive in vineyards, 82.
  Katydids, musical organs of, 68.
    tree-crickets, description of, 68.
  Kissing-bugs, 76.
  Lace-winged flies, predaceous upon aphids, 92.
  Lacosomidæ, a family of moths, 109.
  Ladybirds, list of beneficial, 137.
  Lamellicornia, a tribe of beetles, 134.
  Lampyridæ, the fire-flies, 134.
  Larridæ, a family of Hymenoptera, 152.
  Lasiocampidæ, the tent-caterpillars, 108.
  Legs of insects. 52.
    modified to meet requirements, 52.
  Lemoniidæ, tropical butterflies, 102.
  Lepidoptera, order, description of, 97.
    destructive in their larval form, 98.
  Leptidæ, the snipe-flies, 122.
  Leptocoris trivittatus, the box-elder bug, 79.
  Limnobatidæ, the marsh-treaders, 75.
  Liparidæ, the tussock-moth, 107.
  Locusts, methods of oviposition, 64.
    damage from in California, 66.
    Rocky Mountain, destruction by, 65.
    seventeen-year, 81.
  Lomchopteridæ, spear-winged flies, 122.
  Lucanidæ, stag-beetles, 134.
  Lycænidæ, a family of butterflies, 102.
  Lygæidæ, the chinch-bugs, damage from in the Mississippi Valley, 78.
  Maggots, the larvæ of flies, 116.
  Malophaga, order containing bird-lice, 96.
  Mantis, the praying, predaceous upon other insects, 63.
  Mantispidæ, resemblance to the praying mantis, 91.
  Margarodinæ, a subfamily of Coccidæ, 88.
  Masicera pachytyli, a tachnid fly parasitic on locusts, 126.
  Mecoptera, order of, 93.
  Megalopygidæ, the flannel-moths, 110.
  Melanoplus devastator, in California, 66.
  Melanoplus spretus, Rocky Mountain locust, 65.
  Melanolestes picipes, kissing-bug, in California, 77.
  Meloidæ, the blister-beetle, 139.
  Membracidæ, tree-hoppers, 83.
  Metamorphoses, in different species, 69.
  Micropterygidæ, a family of moths, 115.
  Midaidæ, a family of flies, 122.
  Mimesidæ, a family of Hymenoptera, 152.
  Molluscoidea, description of, 38.
  Mollusca, shell-fish, etc., 39.
  Monarch butterfly, description of, 101.

ENTOMOLOGY—*Continued.*
  Monophlebinæ, subfamily of Coccidæ, 88.
  Mosquitoes, disease spread by, 120.
  Moths, description of, 97.
    destruction from, 104.
    families of, 104.
  Mouthparts of insects, structure and uses, 47.
  Mud-daubers, their peculiar habits, 151.
  Muscidæ, common house-flies, 125.
  Muscinæ, subfamily embracing house-flies, 126.
  Musca domestica, the house-fly, 126.
  Mutillidæ, velvet ants, 151.
  Mycetophilidæ, mosquito-like flies, 121.
  Myriapoda, description of, 40.
  Myrmeleonidæ, doodle-bugs, their peculiarities, 92.
  Nabidæ, the damsel-bugs, 77.
  Natural kingdom, divisions of, 39.
  Naucoridæ, the creeping water-bug, 75.
  Nemistrinidæ, a family of flies, 122.
  Nepidæ, the water-scorpions, 73.
  Nervous system of insects, 57.
  Neuroptera, the nerve-winged insects, description of, 91.
    families in, 91.
  Noctudidæ, the owlet-moths, 107.
  Nolidæ, a family of moths, 109.
  Notonectidæ, the back-swimmers, 73.
  Notodontidæ, moths resembling the owlets, 107.
  Nycteolidæ, a family of moths, 107.
  Nycteribiidæ, bat-ticks, 128.
  Nymphelidæ, the four-footed butterflies, 100.
  Nyssonidæ, a family of Hymenoptera, 152.
  Ocelli, simple eyes in insects, 47.
  Odonata, order including the dragon-flies, 93.
  Œcophoridæ, a family of moths, 114.
  Œdaleonotus enigma, destructive grasshoppers in California, 67.
  Œstridæ, the bot-flies, 124.
  Opticœtus personatus, the masked bedbug hunter, 76.
  Orders of insects, 61.
  Organs, internal, 55.
    digestive, 55.
  Orphnephilidæ, the solitary midgets, 121.
  Ortheziinæ, subfamily of Coccidæ, 88.
  Orthoptera, description of, 61.
    families of, 61.
      Acrididæ, the locusts, 64.
      Blattidæ, or roaches, 62.
      Gryllidæ, crickets, 68,
    Locustidæ, 67.
    Mantidæ, family of, 63.
    Phasmidæ, family of, 63.
    metamorphoses of, 61.
  Orthorrhapha, a suborder of Diptera, 118.
    families included in, 118.
  Otiorhynchidæ, a family of beetles, 139.
  Ox warbles, 124.
  Papilionidæ, the swallow-tailed butterflies, 102.
  Parnidæ, a family of beetles, 133.
  Peach-twig borer (Anarsia lineatella), 114.
  Peach-borer, the Sinuate, 133.
  Pea-weevil, 136.

ENTOMOLOGY—*Continued.*
Pelecinidæ, a family of Hymenoptera, 149.
Pemphredonidæ, a family of Hymenoptera, 152.
Pentatomidæ, the stink-bugs, 79.
Pericopidæ, a family of moths, 107.
Phenacoleachiinæ, a subfamily of Coccidæ, 88.
Philanthidæ, a family of Hymenoptera, 152.
Phoridæ, humpbacked flies, 124,
Phylloxera vastatrix, manner of propagation, 86.
Phymatidæ, the ambush bug, 77.
Phryganidia californica, the California oak-moth, 107.
Physopoda, order including thrips, 96.
Phytophaga, section of Coleoptera described, 135.
Pieris rapæ, its introduction into America, 103.
Pigeon tremex, damage to forest timber by, 142.
Pines, yellow and sugar, attacked by Ergates spiculatus, 137.
Pipunculidæ, parasitic flies, 123.
Platypterygidæ, a family of moths, 109.
Plecoptera, description of, 94.
Plume-moths, species in the United States, 113.
Pompilidæ, the spider-wasp, 151.
Poriferata, description of, 38.
Prionus californica, destructive in orchards, 137.
Prionidus cristatus, the wheel-bug, 77.
Prionoystus robiiæ, moth destructive of forest trees in California, 111.
Proctotrupidæ, family of parasitic Hymenoptera, 147.
Protozoa, description of, 38.
Psychidæ, the bag-worms, 110.
Psyllidæ, jumping plant-lice, 83.
Psylla pyricola, destructive to pear trees, 88.
Psychodidæ, a family of flies resembling moths, 119.
Ptermalus puparum, parasitic on the cabbage butterfly, 147.
Pterophoridæ, the plume-moths, 113.
Ptinidæ, injurious to vegetable matter, 134.
Pulex irritans, 128.
Pyralidæ, a family of small moths, 113.
Pyrrhocoridæ, the red bugs, 78.
Raphidiidæ, predaceous on the codling-moth, 92.
Reduviidæ, the assassin-bugs, 75.
Respiration, method of, 56.
Rhopalocera, suborder of Lepidoptera, including butterflies, 97, 100.
Rhyncophora, a suborder of Coleoptera, 139.
  the snout-beetles, 130.
Robber-flies, beneficial insects, 122.
Rove-beetles, 132.
Ryphidæ, false crane-flies, 121.
Salididæ, the shore-bugs, 75,
Saltatoria, section of Orthoptera, 62.
Sanninoidea opalescens, life history of, 112.
Sapygidæ, a family of Hymenoptera, 151.
Sarcophaginæ, the flesh-flies, 126.

ENTOMOLOGY—*Continued.*
Saturniidæ, the wild silkworms, 105
Scarabæidæ, the May-beetles, etc., 134
Scenopinidæ, the window-flies, 122
Sciences, natural, division of, 37.
Scoliidæ, a parasitic wasp, 151.
Scolytidæ, the engraver-beetle, 139
Screw-worm (Compsomyia macellaria), 127.
  attacks upon men and animals, 117.
Scutelleridæ, the shield-back bugs, 79.
Serricornia. a tribe of beetles, 133.
Sheep-tick, 128.
Shield-back grasshopper, represented in California by Stenopelmatus irregularis, 68.
Sialidæ, the Dobson-fly, 92.
Silphidæ, the burying-beetles, 132.
Simuliidæ, the black-flies, 121.
Siphonaptera, order including fleas, 128.
Siricidæ, a family of Hymenoptera, 142.
Social wasps, 152.
Soldier bugs. 134.
Sphecidæ, thin-wasted wasp, 151.
Sphecina, the digger-wasp, 150.
Sphingidæ, the hawk-moths, described, 104.
Spittle-bugs, destructive to plants, 82.
Stable-fly (Stomoxys calcitrans). 127.
Staphylinidæ, the rove-beetles, 132.
Stephanidæ, a family of Hymenoptera, 145.
Stratiomyiidæ, the soldier-flies, 122.
Stylopidæ, parasitic on wasps, 129.
Syntomidæ, a family of moths, 105.
Syrphidæ, the syrphus-flies, 123.
Syrphus-flies, predaceous on aphids, 123.
Tabanidæ, the horse-flies, 121.
Tachininæ, a beneficial family of flies, 125.
Tachina fly, destructive to grasshoppers in California, 66.
Tachardiinæ, a subfamily of Coccidæ, 89.
Tarantula hawk (Pepsis formosa), 151.
Tenebrionidæ, darkling beetles, description of, 138.
Tent-caterpillars, destructive in orchards, 108.
Tenthredinidæ, the saw-flies, 142.
Terebrantia, a suborder of Hymenoptera, 141.
  families included in, 141.
Termites, or white ants, description of, 95.
  sometimes mistaken for ants, 149.
Tetramera, section of Coleoptera, described, 135.
Therevidæ, stiletto-flies, 122.
Thorax, and its appendages, 51.
Thrips, destructive to vegetation, 97.
Thyatiridæ, a family of moths, 107.
Thyrididæ, a family of moths, 111.
Tiger-beetles. habits of, 130.
Tineidæ, a family including the clothes-moths, etc., 114.
Tingitidæ, the lace-bugs, 77.
Tipulidæ, the crane-flies, 119.
Tortoise beetles, 136.
Tortricidæ, the leaf-rollers, 113.
Tracheæ, form and use of, 56.
Transformation of insects, 58.
Trichoptera, order including the caddice flies, 93.

ENTOMOLOGY—Continued.
  Trypeta ludens, 127.
  Tussock-moth, a pest in California, 107.
  Veliidæ, the broad-shouldered water-striders, 75.
  Vermes, worms, leeches, etc., 38.
  Vertebrata, 38.
  Vespina, the true wasps, description of, 152.
  Walking-sticks, a peculiar class of insects, 64.
  Weevils, 139.
  Western peach-root borer (Sanninoidea opalescens), 111.
  White ants, description of, 95.
  White fly, destructive to citrus fruits in Florida, 87.
  Wings, 52.
  Wire-worms, the larva of click-bettles, destructive to crops, 134.
  Xylorictidæ, a family of moths, 114.
  Yellow jackets, 152.
  Ypononeutidæ, a family of moths, 114.
  Zygænidæ, a family of moths, 111.

Eriococcus azalea, cherry trees infested by, 25.
Eulecanium armeniacum, 23.
  tulipiferæ, 23.
Euthrips pyrii, 22, 30.
Expenditures, list of, 18.

Financial statements, 18.
Flat-headed borer, remedy for, 226.
Flea-beetle, grapevine, 22.
Florida, white fly in, 16.
Fresno County, report of Horticultural Commission, 279.
Fresno, reclamation of alkali land in, 251.
Fruit-growers' Conventions, 11.
Fruit shipments, 1905 and 1906, 34.

Grapes, crop and shipments for 1905, 30.
  crop and shipments for 1906, 33.
Grape-leaf mite, damage by, 24.
Grasshoppers, 22.
  remedies against, 329.
Green apple louse, damage from, 227.
Gypsy-moth, 16.
Gypsy and brown-tail moths, 236.
  destruction by, in Massachusetts, 236.

Haltica bimarginati, 22.
  torquata, 22.
Horticulture, reports of Deputy Commissioner of, 20.
Horticultural Commissioners, county, assistance from, 15.
  horticultural conditions, 11.
Humboldt County, report of Horticultural Commission, 280.

Icerya purchasi, 23.
Insectary, destroyed by the San Francisco earthquake, 15.
  work in the, 21.
Insects, beneficial, 9.
  beneficial, destroyed by earthquake, 16.
  beneficial, importations of, 21.
Insect pests, 21.

Lassen County, report of Horticultural Commission, 281.
Lepidosaphes beckii, 23.
Los Angeles County, report of Horticultural Commission, 282.

Madera County, report of Horticultural Commission, 289.
Mendocino County, report of Horticultural Commission, 289.
Merced County, report of Horticultural Commission, 290.
Monterey County, report of Horticultural Commission, 291.
Melon aphis, increasing largely, 228.
Melon fly, tomatoes infested by, destroyed, 25.

Novius cardinalis, working on cottony-cushion scale, 224.
  koebelei, 10.
Nuttall sheep-moth, in destructive numbers, 226.
Nursery stock, quarantine against, 16.

Oak-tree caterpillar, checked by parasites, 227.
Orange County, report of Horticultural Commission, 291.
Orange-maggot, Mexican, report on, 13.
Orange-worm, Mexican, investigation of, 10.
  precautions against, 27.

Parasites, work on, 8.
Peach blight, description of, 239.
  damage from, 24, 31.
  remedy for, 246.
  treatment of, 242.
Peaches, crop and shipments for 1905, 28.
  crop and shipments for 1906, 31.
Peach-moth (Anarsia lineatella), 22.
  checked by spraying, 225.
Peach-root borer, work against, 225.
Pear blight, checking, 10.
Pears, crop of 1905, 29.
  crop and shipments for 1906, 32.
Pear diaspis (Epidiaspis pyricola), checked by twice-stabbed ladybird 224.
Pear-leaf blister mite, 24.
Pear thrips, reduced in quantity, 229.
Phytoptus pyrii, 24.
Placer County, report of Horticultural Commission, 292.
Plants, importations of, 20, 24.
  infested by insects, destroyed, 25.
Plums, crop and conditions for 1905, 29.
  crop and shipments for 1906, 32.
Prunes, crop and conditions for 1905, 29.
  crop and shipments for 1906, 32.
Publications issued by the Commission, 11, 17.
Purple scale (Lepidosaphes beckii), 23.
  in California, 224.

Quarantine department, work of, 17.
Quarantine against nursery stock, 16.
Quarantine, horticultural, 7.

Red hump caterpillar, serious in some localities, 226.
Red scale (Chrysomphalus aurantii), 224.
Red spiders, decrease in numbers, 24.
  and mites, 230.

- Rhizobius ventralis, 10.
- Riverside County, report of Horticultural Commission, 293.
- Rose-beetle, Fuller's, 22.

- Sacramento County, report of Horticultural Commission, 295.
- Saissettia oleæ, 23.
- San José scale (Aspidiotus perniciosus), checked by parasite, 224.
- Santa Rosa, Fruit-growers' Convention at, 11.
- San Bernardino County, report of Horticultural Commission, 297.
- Santa Barbara County, report of Horticultural Commission, 303.
- Santa Clara County, report of Horticultural Commission, 305.
- Santa Cruz County, report of Horticultural Commission, 306
- San Diego County, report of Horticultural Commission, 299.
- San Joaquin County, report of Horticultural Commission, 302.
- Scale insects, 23.
- Scutellista cyanea, work on black scale, 9, 23, 223.
- Shasta County, report of Horticultural Commission, 307.
- Silk-raising, experiments in, 261.
- Silkworm, report on rearing, 261.
  - treatment during first age. 269.
  - treatment during second age, 269.
  - treatment during third age, 269.
  - treatment during fourth age, 269.
- Silkworm, treatment during fifth age, 270.
- Soft tulip scale, 23.
- Stanislaus County, report of Horticultural Commission, 308.
- State Fair, exhibit at, 17.

- Tehama County, report of Horticultural Commission, 309.
- Thrips, 22.
- Tomocera californica, work on black scale, 223.
- Tomato-worm, damage by, 227.
- Trypeta ludens, 13.
  - in Mexico, 11.
- Tulare County, report of Horticultural Commission, 309.
- Tussock-moth, increase of, 226.

- Vedalia cardinalis, 10.
- Ventura County, report of Horticultural Commission, 312.
- Vine-hoppers, damage from, 229.
- Vine sphinx-moth, remedy for, 227.

- Walnuts, blight of, 30.
  - crop and shipments for 1905, 30.
  - crop and shipments for 1906, 33.
- Woolly-aphis, remedy for, 228.

- Yellow mite, 24.
- Yellow scale, 23.
- Yolo County, report of Horticultural Commission, 313.
- Yuba County, report of Horticultural Commission, 313.

LIBRARY OF THE UNIVERSITY OF CALIFORNIA

STORED AT NRLF

THE UNIVERSITY LIBRARY
UNIVERSITY OF CALIFORNIA, SANTA CRUZ

This periodical is due on the last **DATE** stamped below.
To renew by phone, call **429-2756**

80m